MACHINERY.

Vol. 7. May, 1901. No. 9.

THE BROWN & SHARPE MFG. CO.'S WORKS.—2.

SMALL TOOLS AND JIGS—NOTES FROM DIFFERENT DEPARTMENTS.

In any machine shop engaged in manufacturing, the character of the work produced can be judged by the use that is made of small tools and fixtures. It is possible to obtain accurate results without an elaborate outfit of such tools, as witnessed by the beautiful work of some of the earlier mechanics; but no shop can produce strictly high grade machines in quantities, and at a price to compete in the open market, without an adequate equipment of small standard tools used in connection with jigs and fixtures. This is the only way to secure uniformity of product, and where such means are in extensive use it is presumptive evidence, at least, that the work is well and accurately done.

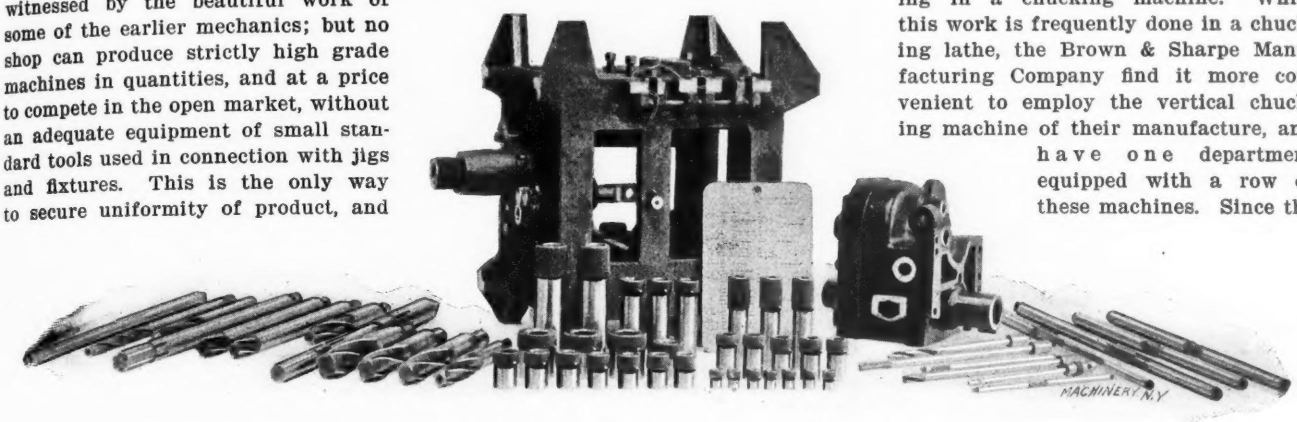


Fig. 1. Jig and Tools for Drilling Feed Gear Case for an Automatic Gear Cutting Machine.

In mentioning certain features of the shop practice of the Brown & Sharpe Manufacturing Company, therefore, attention should first be called to their small tools and the use of such tools in connection with jigs and fixtures. Nowhere, to our knowledge, can so extensive a collection of small tools be found. They are kept in groups, to a certain extent, each group being adapted for one particular piece of work, or for one set of operations. While primarily the uniformly high standard of the Brown & Sharpe machines may be due to the careful inspection insisted upon and rigidly adhered to for each machine, the inspection requirements could not by any possibility be lived up to without shop methods adequate to the demands. No better testimonial to the superiority of these methods could be offered than the photographs of the jigs and tools which we reproduce, coupled with the statement that they are representative of hundreds of similar outfits for producing the various parts of something over seventy different machines, not to mention the machinists' tools and sewing machines that are manufactured.

The simplest use to which small tools are put is for boring in a chucking machine. While this work is frequently done in a chucking lathe, the Brown & Sharpe Manufacturing Company find it more convenient to employ the vertical chucking machine of their manufacture, and have one department equipped with a row of these machines. Since the work is chucked on a horizontal table, the chips drop freely to the floor. The turret has five holes, and the usual equipment consists of the four tools shown in Fig. 3 to which can be added a drill in case the hole to be bored and reamed is not cored in the casting; or a second single-pointed boring tool, in the case of extremely accurate work. The first tool to be fed through the hole is the boring tool, because this form of tool will best true up a rough hole by removing the metal at the high points without at the same time digging into the opposite side, owing to the springing of the tool. For the next operation the four-lip, spiral drill is employed, and this also has a tendency to true up the hole, in that the cutting is done by the ends of the four lips. The cutting edges make only a slight angle with the axis of the drill, and when a high spot is encountered there is but little tendency to crowd to one side. This form of four-lip drill is a feature of many of the boring tools at these works, both for chucking and boring machines, and the usual rule

Fig. 2. Jig and Tools for Boring Grinding Machine Head and Foot Stocks.

is to make them .010" under size, leaving this amount of stock to be taken out in reaming. The third operation in chucking is done with the machine, or roughing reamer, which is ordinarily made .004" under size for all classes of work; and the final operation is with the finishing reamer, which is an expansion reamer to permit regrinding without

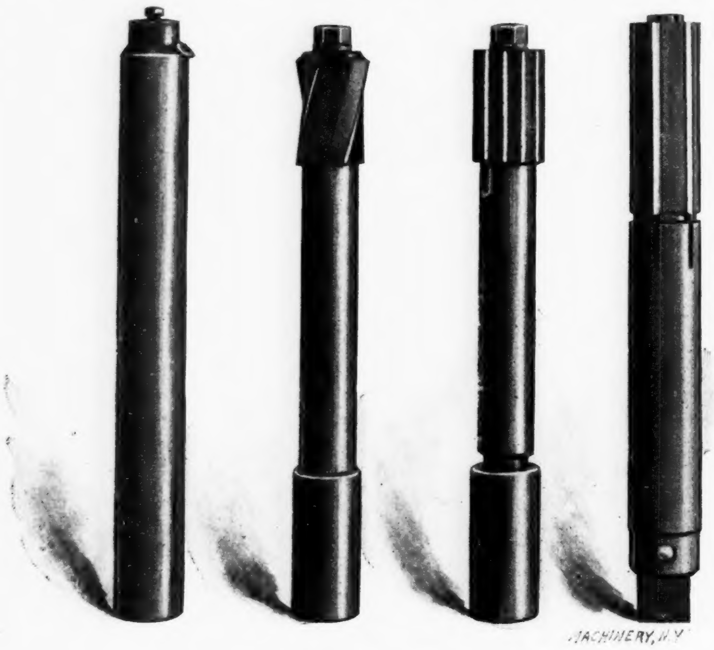


Fig. 3. Chucking Tools.

destroying the size. This reamer may be supported by a floating collet, if desired.

In Fig. 4 is a group of tools and a fixture for boring the various holes in the saddle feed-screw bracket of the No. 5 vertical spindle milling machine. These tools differ from those just described only in that the cutting edges are at the center of the body of the tool instead of at one end, in order to give a double support to the tool when cutting. The work is done on a horizontal boring machine, and the boring tools and reamers are supported on each side of the piece being operated on by hardened bushings. This plan is very generally followed in all kinds of jig work, and is the most reliable method for accurate boring. The jig illustrated in Fig. 4 is of the box type; that is, the casting is placed within the jig and any of the six faces of the jig can be set on the table of the machine to enable holes to be bored in the casting in any of six directions.

A feature of this fixture, and of all the jigs and fixtures throughout the works, where it is feasible to apply the principle, is the use of slip bushings. The outside diameters of these bushings are made interchangeable. They can be easily withdrawn or placed in position in the jig and bushings of different internal diameters can be used in the same hole in any jig. Furthermore, by removing a bushing and passing the boring bar through the hole in which the bushing is fitted, it is not necessary to take the cutter or reamer from the bar when placing the latter in position for boring. This allows the cutter and bar to be in one piece if desired.

The four-lip drills used with this outfit are made of solid bars of tool steel, turned somewhat smaller than the outside diameter of the lands of the drill, with the exception of a short length at or near the center. This portion is then fluted, hardened and the whole tool ground. Boring tools or cutters of this description last for a long time, since they are sharpened only on the ends of the lips. This solid construction is followed, even where holes of quite large diameter are to be bored or long bars must be used. At first thought it seems like an extravagant expenditure for tool steel, but a brief calculation shows that the added cost of steel, even for a bar of considerable proportions, would not equal the labor cost of producing some of the more complicated forms of bars with shell reamers—which bars, moreover, must be of smaller diameter, and consequently weaker, to fit the hole in the reamer.

The finishing reamers shown with the outfit are expansion reamers, the bar being an integral part of the reamer just as with the usual form of expansion reamer having a single shank at one end. The three facing tools also shown on the table of the boring mill are of interest.

The elaborate layout in Fig. 1 is from a photograph of a collection of tools and bushings used in drilling and boring the casting at the right of the engraving after it has been placed in the jig, which is the central figure. The tools are all of the same character as those already mentioned, modified somewhat to suit special conditions. Part of the bushings are unusually long, and are designed to firmly support the cutters and reamers where it is not possible to extend the shank through the work to support the cutter on both sides of the hole. In the room where this and similar outfits are stored, each set of tools is kept separate from the others, and an index card is provided on which is complete information for each set. In the first column are the sizes and locations of the holes, and then follow the list of tools for each hole and the diameters that will be produced by each tool as it is used, together with any other needed information.

In Fig. 2 is shown a fixture for boring the head and foot stocks of grinding machines. The jig shown at the left is clamped to a knee and used for reaming.

Inspection Department.

Nowhere are time and experience more necessary than in the establishment of an inspection department. It requires time to establish it as a part of the regular order of operations in manufacturing and to have it so regarded throughout the works; and it takes experience to determine what limits should be stipulated and what weak points must be guarded against.

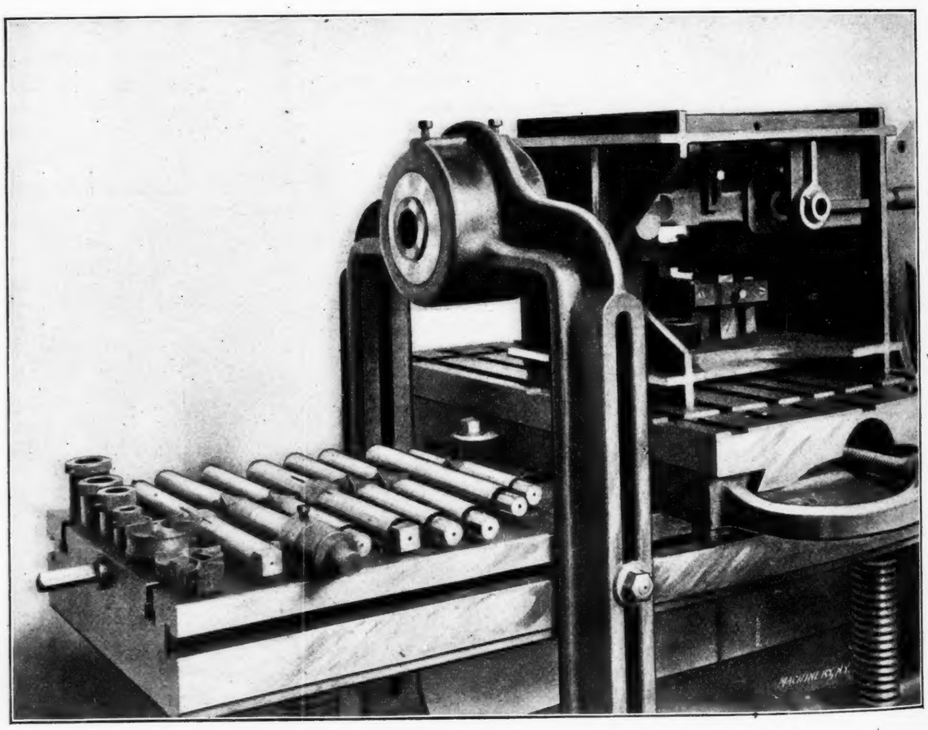


Fig. 4. Tools and Fixtures for Boring Feed Screw Bracket, No. 5 Vertical Milling Machine.

The chief inspector is backed by the authority of the superintendent, and the parts of machines must first pass through the hands of his assistants, and then each completed

machine is gone over very carefully and thoroughly before it leaves the erecting floor. The inspector's truck, such as shown in Fig. 5, is a familiar object in these works. Each inspector is provided with one, and each truck has the necessary outfit of tools, test indicator, test bars and plugs, etc., to answer the ordinary requirements. The truck is on rollers, so that it can be moved easily to any part of the floor. The front of the upper large drawer is supported at each end by a swinging arm so that when the drawer is

Fig. 5. Inspector's Truck.

pulled out the front will drop a few inches, letting the drawer rest on an incline and making the tools more accessible. The work of each inspector is governed by a set of tabulated requirements, naming each part that is to be inspected, the allowable limits, etc., and each item on the list must be taken up and checked, and finally a slip made out and filed for reference.

Tool-making Department.

On the fourth floor of the main building is the department where the small tools are made that are in use in the various departments of the works. A feature of this floor is the extensive system of drawers and cabinets for storing gages, reamers, taps, and other small tools that must be kept in good condition and be easily accessible. The drawers in which these small parts are stored do not slide into their places horizontally, but the guides or strips upon which they slide are inclined upward toward the back, and when pushed in the drawers are held in this inclined position by spring pins. When they are pulled forward they slide out, resting in an inclined position, where their contents can easily be reached. There is a set of plug gages and reamers in this room from .045" diameter to .5" diameter, varying by thousandths of an inch.

All lathe centers are brought to the tool-making department for grinding. A special machine is used for the purpose, in which the wheel travels back and forth at an angle of 60 deg. with the axis of the lathe center. Collets of different internal tapers are employed for holding the centers of different lathes, and it is an interesting commentary on the present system of local option with respect to tapers that there are 18 different tapers in the lathe spindles in use in the Brown & Sharpe works. Inasmuch as most of the lathe work in these shops is finished by grinding, lathes being used mainly for roughing, it is not considered necessary to grind the centers in place in the lathe.

A convenience in the way of stock kept on hand in this department is thin strips of tool steel ground accurately to different thicknesses to be used for the various requirements of tool-making. The forming tools made here are superior to such tools usually found, in that they are accurately formed and are on the same plan as threading tools, which need be ground on their tops only, thus retaining their shape as long as used.

Tool Rooms.

The requisites of a tool room are that it shall form a convenient place where tools and appliances may be kept systematically and conveniently distributed. For convenience in distributing there must be a number of tool rooms in an extensive establishment where there are several buildings and several floors in each building. The different tool rooms here are much alike, the largest one being on the second floor of the main building, where all lathe tools are ground on a Sellers grinder before being given out, and other work

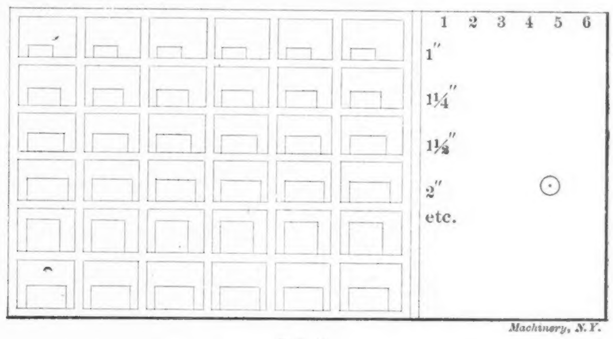


Fig. 6.

of like character done. The check system is in use, each workman being provided with ten checks, after the usual custom, which are placed opposite the place occupied by a tool that is out. One noticeable feature that cannot fail to be appreciated is a good supply of parallels, and to save checks in case a workman needs several parallels, the system shown in Fig. 6 was adopted. The parallels are placed in pigeon holes, those of one size in one row, the next larger in a row below, and so on. At the right is a board, on the side of which is marked the size of the parallels in each row, and on the top of which are the numbers 1 to 6 to indicate the number of parallels in use. A check hung in the position shown would indicate that a workman had out five two-inch parallels.

It is quite common in many shops to keep sets of taps and tap drills together in one block, the whole being given out on one check. The tap blocks here are more completely equipped than usual. They contain a full sized drill, tap drill, starting, sizing and bottoming tap; two counterbores for holes where counter-sunk head screws are used, one counterbore having a tit the size of a standard hole, and the other to fit a tap drill hole; a test plug, giving the size of a standard head for screws of that size, and a tap wrench.

To keep track of supplies, like emery cloth, oil, etc., there is in each tool room a six-sided case, on the sides of which hang an extra size of 10 checks for each man. In the top of the case are several divisions, marked, respectively, "Oil," "Waste," "Towels," "Emery Cloth," etc., and when a man wants a piece of emery cloth one of his checks is dropped into the receptacle bearing this name. At the end of a week, or any specified time, the checks are put back on their pins again and the record taken of what each man has used in the way of supplies.

Gear-cutting Department.

In the gear-cutting department the work is largely done on automatic gear cutters, these machines being supplemented by the milling machine, bevel gear planers and a number of special machines. Fig. 5 of the group, on page 273 is a good example of automatic gear-cutting. One machine is roughing out a large blank, and the other one in the foreground is completing a gear with one operation of the cutter for each tooth.

There are always a number of operations in progress that are out of the ordinary, and one of these is illustrated in Fig. 7. It would be difficult for any mechanic, however well versed in the subject of gearing he might be, to tell

upon first sight just what the machine in this illustration is doing. There is evidently a milling cutter with attached teeth, resembling a hob, which is operating on what looks like a worm. But who ever heard of hobbing a worm? As a matter of fact, the hob is operating on a *worm wheel*, according to the strict definition of the term, and the worm with which it runs is four times the diameter of the wheel. The worm and worm wheel are used on the Brown & Sharpe automatic gear-cutting machine for driving the cutter arbor. The smaller member resembles a Hindley worm, and does the driving. The larger member is virtually a spiral gear, both in appearance and form. The distinction whereby the spiral gear is classed as a worm and what appears to be the worm, is classed as the worm wheel, lies in the method of cutting the teeth and in the shapes of the teeth. According to the definition given by Mr. O. J. Beale, an axial plane passed through a worm would so cut its teeth or thread as to display a cross section like the cross section of a rack; and if the plane be continued so as to pass through the worm wheel in mesh with the worm and cut its axis at right angles, it would show a section resembling a spur gear in mesh with the rack teeth of the worm section. These conditions are met in this combination of the worm and worm wheel only by considering the small member the wheel and the larger one the worm.

In finishing small bevel gears, such as bicycle gears, a special machine is used. As is well known, bevel gears cut with milling cutters are only approximately correct in shape, and have to be fitted before they will run properly. This machine does the fitting on small gears, taking the place of the hand file. A crown gear is used for the tool. A crown gear is a bevel gear in the form of a flat disk, on the face of which are the teeth with their apices at the center of the face of the gear. A crown gear will mesh with any bevel gear of its pitch when the two have the same apex point. This gear is of tool steel, with file teeth cut on the sides of its teeth. It is run in contact with the gear to be finished, the two being gradually brought together. In case considerable stock is to be removed, a crown gear is used, with every other tooth truncated; that is, reduced in height, leaving sharp edges that act as scrapers upon the teeth of the gear to be trued up.

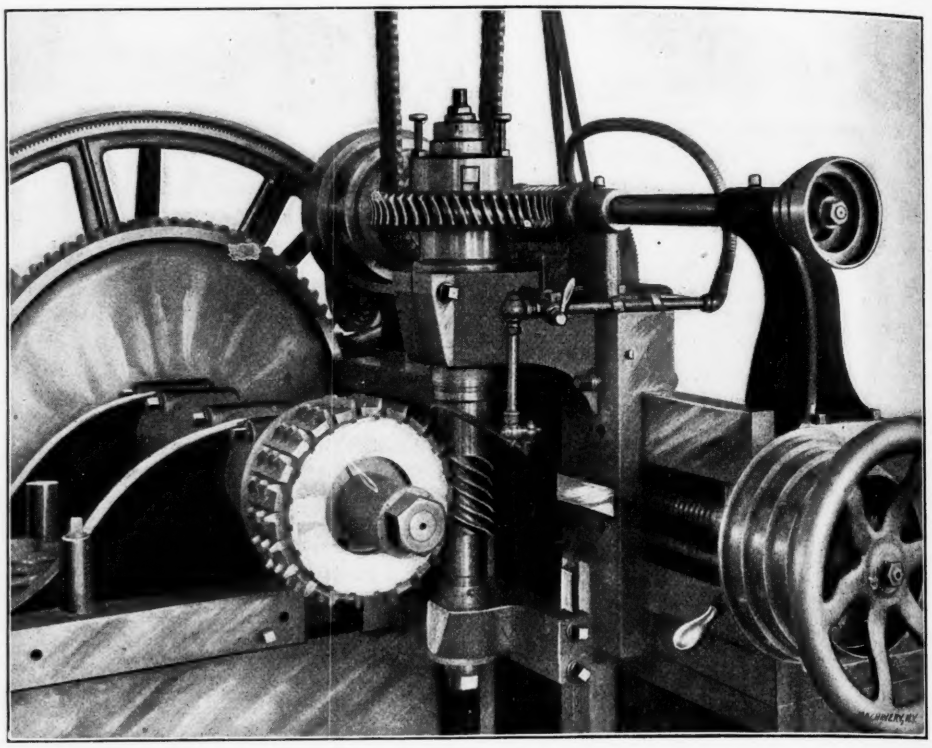


Fig. 7. Hobbing a Worm Wheel which has the appearance of a Hindley Worm.

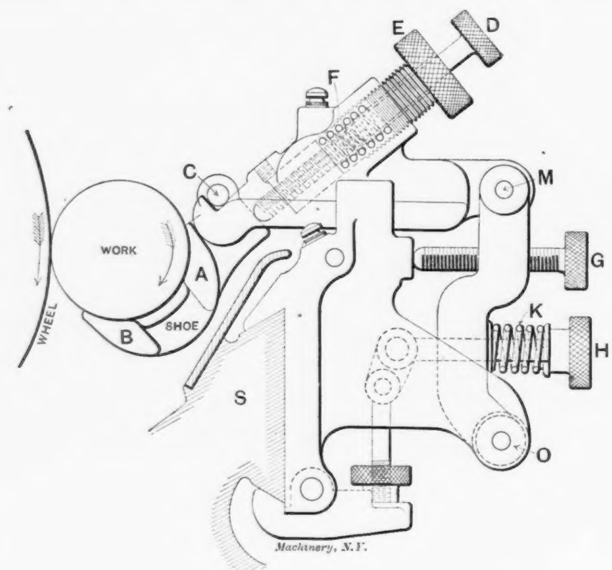


Fig. 8

Grinding Department.

In the grinding department, a view of which was shown in the last number of the paper, one of the devices in use is a new design of universal back rest. This is built in two styles, one of which is adapted to the recent designs of plain grinding machines built by this company, and the other can be attached to most of the styles and sizes of universal machines. Both styles of back rest are upon the same principle. The sketch in Fig. 8 shows the rest as adapted to the plain grinding machines of recent type, in which the ways of the carriage are in the form of a vertical slide of a section shown at *S* in the sketch, and upon which overhanging head and foot stocks slide. The back rest clamps to the slide, *S*, and carries a bronze shoe which bears against the work, as indicated. The shoe is supported at point *C*, about which it pivots, and by adjusting the screw, *D*, the point of which bears against the shoe, the lower end, *B*, of the shoe can be adjusted to or from the work; in other words, the screw, *D*, serves to bring the shoe squarely against the work. The nut in which this screw turns is free to slide longitudinally in a recess in the frame in which is the spring, *F*. This spring keeps the nut seated at the lower end of the recess, but allows an upward movement in case of any irregularity of the work bearing against point *B* of the shoe. The tension of the spring is regulated by the thumbscrew, *E*. The frame of the back rest is also pivoted at points *M* and *O*, and is designed so that the part carrying the shoe can slide horizontally to and from the work. Having been adjusted so that the shoe bears lightly against the work, the screw, *G*, is used to prevent further motion toward the work, and the spring, *K*, adjusted by thumb nut *H*, keeps the shoe against the work in a horizontal direction.

In General.

The views of the group on page 273 show good examples of milling machine practice, and illustrate some of the uses to which the Brown & Sharpe milling machines are put in these works. The milling machine is everywhere, and the planers are but few. The views need but little explanation other than given by the captions. In Fig. 2, aside from the method of supporting the arbor, it will be noted that the cutter is milling one half of a bearing for a shaft and at

the same time is milling the faces and grooves to fit corresponding faces and tongues belonging to the caps of the bearing. In referring to the milling machines, reference should be made to the slotting attachment that is listed in operated it. One of them in the automatic screw machine department is equipped with two sets of tools that are unique. One set is made of round bar steel of different diameters, the whole circumference of the tool being used as a cutting

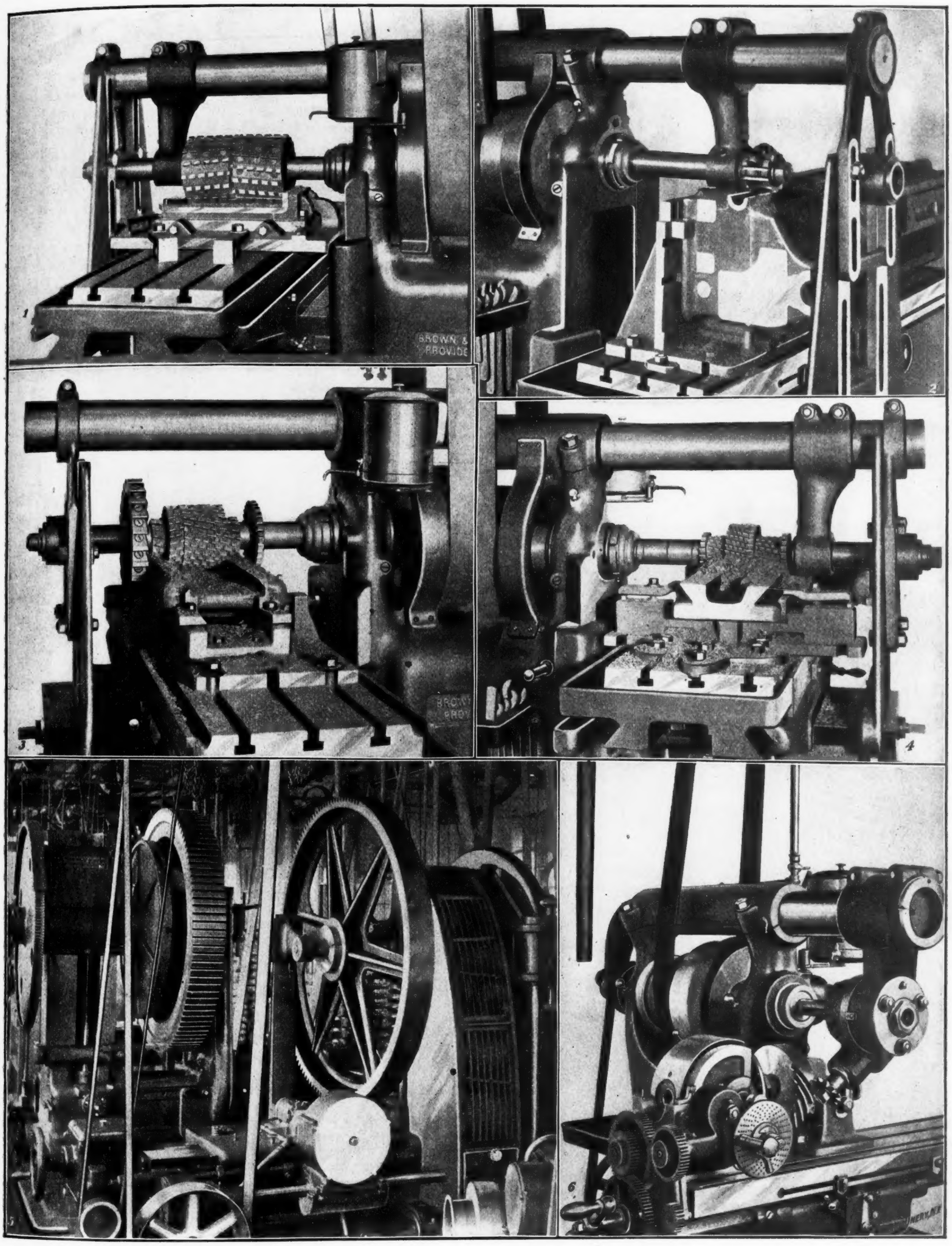


Fig. 1. Milling Vise Beds with Inserted Tooth Cutters.
Fig. 2. Plain Milling Machine, showing Method of Supporting Arbor.
Fig. 3. Milling Saddles for Milling Machines, using a Gang of Cutters.
Fig. 4. Milling Bottom of Milling Machine Tables.
Fig. 5. Automatic Gear Cutting Machines in Operation.
Fig. 6. Vertical Milling Attachment arranged for Cutting Spiral Gears.

EXAMPLES OF MILLING.

the Brown & Sharpe catalogue, and one of which appears in Fig. 8 in the first installment of this series. This attachment is considered a very useful one by those who have edge. The other set is similar, but is made of steel of square section. The cutters resemble round and square punches, but their edges are backed off to give a suitable cutting angle.

DEVICES FOR RINGING CHIME BELLS.

MECHANISM INVOLVING THE TRANSMISSION OF MOTION BY COMPRESSED AIR.

CHAS. L. HUBBARD.

The devices described in the following article were worked out in response to a call appearing in the columns of an engineering magazine for suggestions as to the best method of ringing the newly installed chimes in a large cathedral located in one of our principal Eastern cities. These bells, 26 in number, were hung in an open tower 150 feet above the room where the operating device was to be placed.

The first arrangement, which was operated by electricity, had proved a failure, and the committee in charge took this method of gathering new ideas from anyone who might take sufficient interest in the matter to forward sketches or suggestions.

While none of the devices here shown were adopted in detail, the principle illustrated in Figs. 3 and 4 was selected by the committee and successfully carried to completion. The following sketches are interesting rather from a mechanical standpoint than from any practical value, although the principles involved may prove useful in their application to other purposes where it is desired to obtain similar mechanical movements by a mechanism located at a distance.

The requirements were: First, a striking mechanism at the bells which would be the least affected by exposure to the weather; and second, a light and easy action at the keyboard, with a quick response on the part of the strikers, which must return to their original positions instantly, so that notes might be struck in rapid succession upon the same bell. The first device, shown in Figs. 1, 2 and 3, was designed before the distance from the keyboard to the bells was known, and was not adapted to the actual conditions as learned later. A careful study of the problem suggested compressed air as the most suitable medium for transmitting the power from the keyboard to the strikers, and the various schemes given were worked out along this line. All of the arrangements shown consist essentially of three parts. First, the air-compressing plant, made up of an electric motor, a belted compressor and a receiver or tank, with an automatic device for maintaining a constant pressure within the same. Second, the keyboard with suitable valves for admitting air to the striking device at the bells; and third, the striker or hammer to be placed directly under each bell in the tower. This latter is shown in Fig. 1, and consists of a hammer B, of gun iron, attached to a hickory arm C, and hinged at D to a cast-iron base E. F is a bronze fork in which C rests while supported upon a rubber cushion placed in the bottom of the fork. H is a bronze cylinder and I a smoothly running piston. J is an air pipe connecting the keyboard valve with the lower part of the cylinder, K a thick rubber washer to prevent any shock should

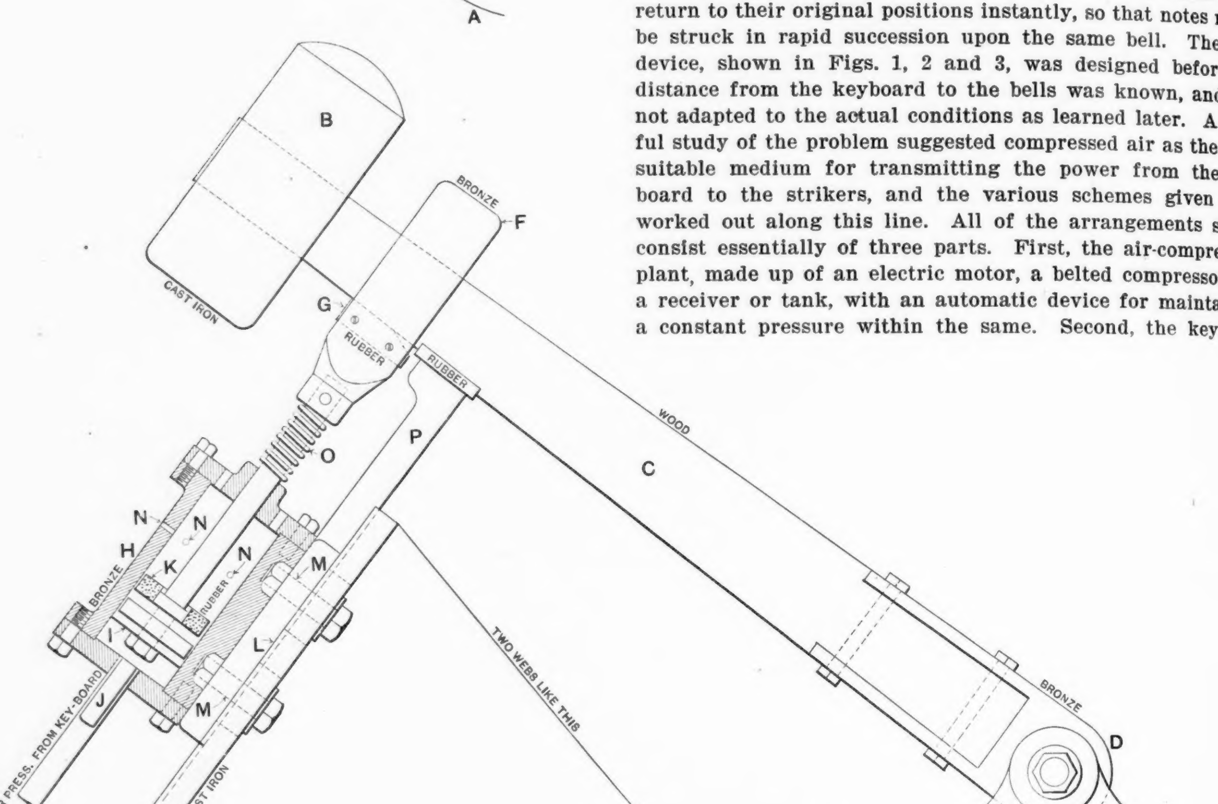


Fig. 1. Bell Striking Mechanism.

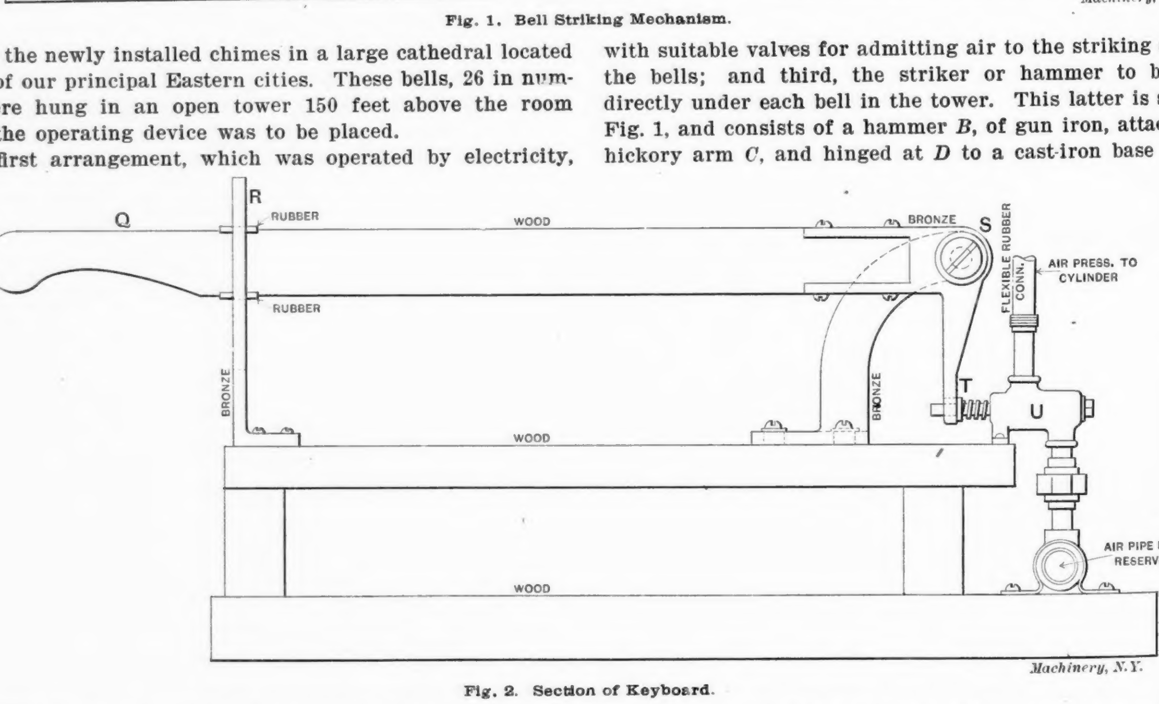


Fig. 2. Section of Keyboard.

the piston at any time be carried against the upper cylinder head by its momentum. The cylinder is bolted to the slide *L* by bolts *M*, *M*, passing through slots, so that the distance between the striker *B* and the bell can be adjusted. *N*, *N*, *N*, are exhaust ports drilled through the sides of the cylinder, and *O* a spring to keep the fork *G* pressed against the arm *C* when in the position shown. When air is admitted through *J* to the cylinder the piston is forced upward, carrying with it

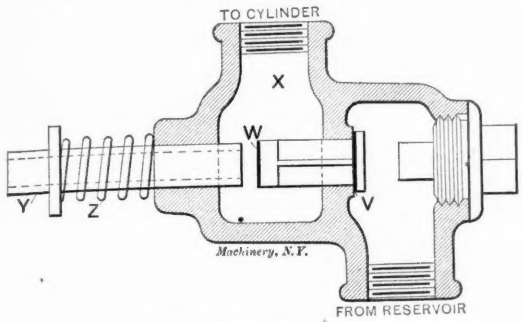


Fig. 3. Section of Air Valve.

the striker *B*. Just before *B* reaches the bell the piston passes the exhaust ports *N*, *N*, *N*, and the pressure behind it is released, but the momentum of *B* carries it upward against the bell with a force which may be adjusted by varying the distance between the striker and the bell when exhaust takes place. *B* at once falls back to its original position (air pressure in the meantime having been cut off at the keyboard by releasing the key), leaving the bell free to vibrate. The arm

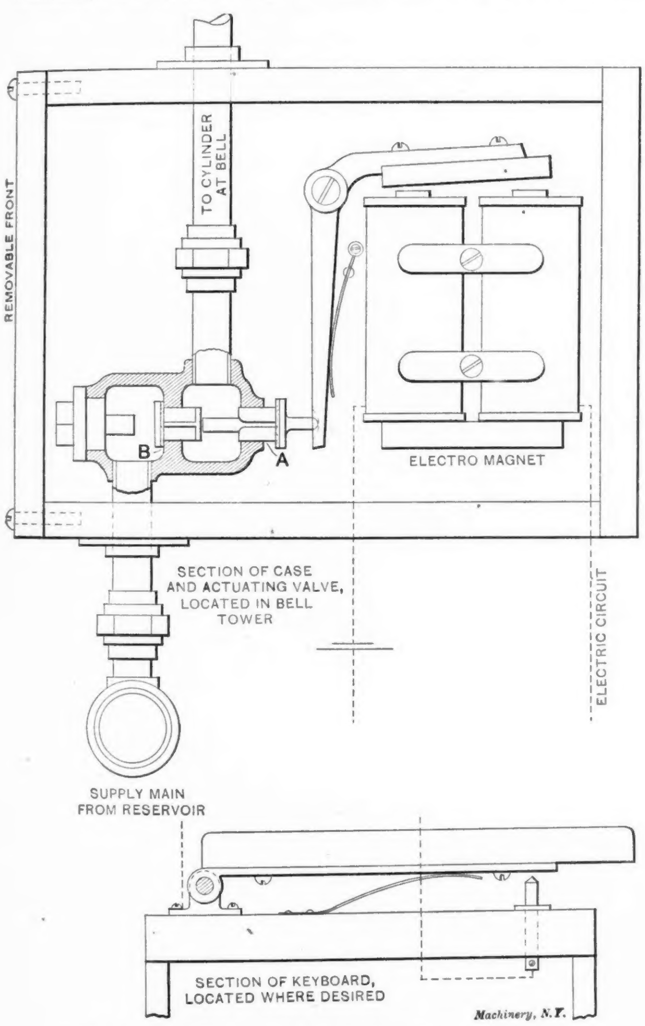


Fig. 4. Showing Method of Controlling the Air Valve.

C is caught on the rubber-capped support *P*, and the piston is kept from being driven back against the lower cylinder head by the spring *O*.

A mechanism of this kind is placed beneath each bell and connected with a separate key on the board below. The size of each striker and cylinder is proportioned to the size of the bell with which it is connected.

Fig. 2 shows a section through the keyboard. *Q* is a wooden handle or key moving vertically in the metal guide *R*, and hinged at *S*. *U* is the valve for admitting air from the pressure main to the striker cylinder in the tower. The valve is shown in section in Fig. 3. Air pressure from the reservoir pipe keeps the valve *V* closed, as shown. When the key is pressed down the lever *T* (Fig. 2) forces in the hollow stem *Y* (Fig. 3) until it strikes the seat *W*, thus cutting off communication between the chamber *X* and the atmosphere. A further depression of the key forces the stem *Y* in still more and opens the valve V, thus allowing air pressure to pass from the reservoir main through the valve to the striker. When the key is released the pressure first closes the valve *V*, and the spring Z draws the hollow stem *Y* away from the seat *W* and allows any pressure there may be in the chamber *X* and the connecting pipe to escape to the atmosphere. The defect in this arrangement lay in the time required to fill and exhaust the long run of pipe between the keyboard valve and the striker cylinder. This was overcome, however, by the arrangement shown in Fig. 4, in which the keyboard valves are placed in a closed case and mounted in the belfrey tower, as near the bells as possible. The pressure is carried from the reservoir to the valves through a main of ample size, and each valve is actuated by an electromagnet, which in turn is operated from a keyboard, which may be placed at any point desired, regardless of the distance. The valve in this case is similar in principle to the one already described. When electric contact is made at the keyboard, the armature of the magnet is drawn down; and this, by means of a connecting lever, pushes in the valve stem and simultaneously closes the exhaust port at *A* and opens the valve at *B*, thus admitting pressure from the supply main to the striker cylinder. In this arrangement the action of the keys may be as light as those of a piano.

* * *

COMING CONVENTIONS.

President Theodore C. Search, of the National Association of Manufacturers, announces that the Executive Committee has selected the dates of June 4, 5 and 6 for the holding of the sixth annual convention of the Association, which will meet in Detroit. These dates, which are somewhat later than the usual time, were chosen in order to secure the advantages of a more favorable season in Detroit than would be found in January, during which month the conventions have usually been held heretofore.

A. S. M. E.

The next meeting of the American Society of Mechanical Engineers will take place at Milwaukee, Wis., May 28th to 31st next. The headquarters during the meeting will be at the Plankinton House, at which house the professional sessions will also be held. Railroad certificate rates of a fare-and-a-third have been secured for all members in attendance on this meeting. Below is the full list of all the papers which will be presented at the meeting, which have been secured to date. Judging from their titles they are one of the most interesting sets of papers ever presented:

Wm. O. Webber—"A Filtration Plant at Albany, N. Y."; "Tests of a Hydraulic Air Compressor." Geo. H. Marr—"Method of Filing and Indexing Engineering Literature; Notes and Data." Committee Report—"On Standard Engine Tests." J. Astrom—"Determination of Fly-wheels to Keep the Angular Variation of an Engine within a Fixed Limit." F. J. Miller—"Bevel Gear Cutting Machines at Paris." F. H. Stillman—"Pulley Press Valve." A. J. Rossi—"Influence of Titanium on the Properties of Cast Iron and Steel." C. H. Benjamin—"Some Experiments on Ball Step-Bearings." A. W. Robinson—"Rules for Drawing Office." W. S. Aldrich—"Requirements of Electricity in Manufacturing Work." J. Riddel "Portable Stationary Machinery Tools." H. G. Reist—"Blue-Printing by Electric Light." A. F. Bardwell and Hamilton—"The Bardwell Volt Meter." G. A. Hutchinson—"Practical Application of Superheated Steam." Chas. Wallace Hunt—"New Connecting Rod End." F. O. and F. H. Ball—"Drafting Room and Shop Systems." Wm. E. Reed—"A Few Instruments of Precision at the Paris Exposition of 1900." W. S. Russel—"Special Forms of Boring and Facing Machine." C. H. Robertson—"Efficiency Tests of a 125 H. P. Gas Engine." J. R. Fordyce—"Method of Preparing and Baling Cotton in Round Bales of Uniform Laps." E. H. Foster—"Superheated Steam." M. P. Wood—"Protection of Ferric Structures."

TURRET LATHE PRACTICE.—1.

THE SEMI-AUTOMATIC TURRET LATHE AND ILLUSTRATIONS OF ITS WORK.

The turret for supporting a series of tools for operating in succession upon a piece of work held in a lathe chuck is believed to have been first tried in this country in 1845, but the feature of rotating the turret automatically as it was moved to and from the work was not introduced until ten years later. At that time turret lathes began to be used to a small extent upon small work, such as parts of guns, etc.

While the early manufacturers of turret machinery appreciated that the manufacture of such parts on the ordinary lathe was altogether too slow a process, they could not have anticipated the extent to which the turret principle was to be carried. If it was correct in principle, however, to use a separate tool for each operation, and have each tool located exactly right for its operation and brought up to its work in rotation, it must be correct, also, for large pieces; and if time was saved by the use of the hand-operated turret, more could be saved if the turret were made partly or entirely automatic. Hence, heavier turret lathes and automatic machines on the turret principle have been built, not only for work made from the bar, but for castings and forgings held in the chuck.

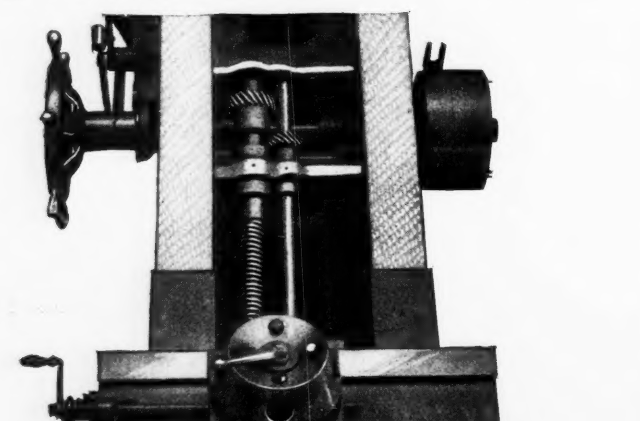


Fig. 2. Top View of Turret and Bed of 24 inch Lathe.

The development in this direction has been so rapid and so many new ideas have been evolved during the past few years, that a description of some of the methods of current turret lathe practice cannot fail to be of value. In this and some future numbers of the paper we shall publish descriptive matter upon the subject that we think will prove of exceptional interest to those who aim to keep versed in the modern methods of doing work.

One of the newer lathes designed for machining castings and forgings is the semi-automatic turret lathe built by the American Turret Lathe Company, Wilmington, Del. This is manufactured in sizes ranging from 20″ swing to 40″ swing. The latest design in this series is the 20″ lathe shown in Fig. 1. While this is slightly different in appearance from the larger sizes, it has the essential features of the others. In all sizes, small as well as large, the carriage is rotated, indexed, and clamped by power and has a rapid travel to and from the work in addition to the slower power feed which is thrown in when the tool approaches the work. This feature has made it possible to construct machines much more massive and for machining heavier work than was possible where the turret, necessarily heavy and massive, had to be manipulated entirely through the muscle of the operator.

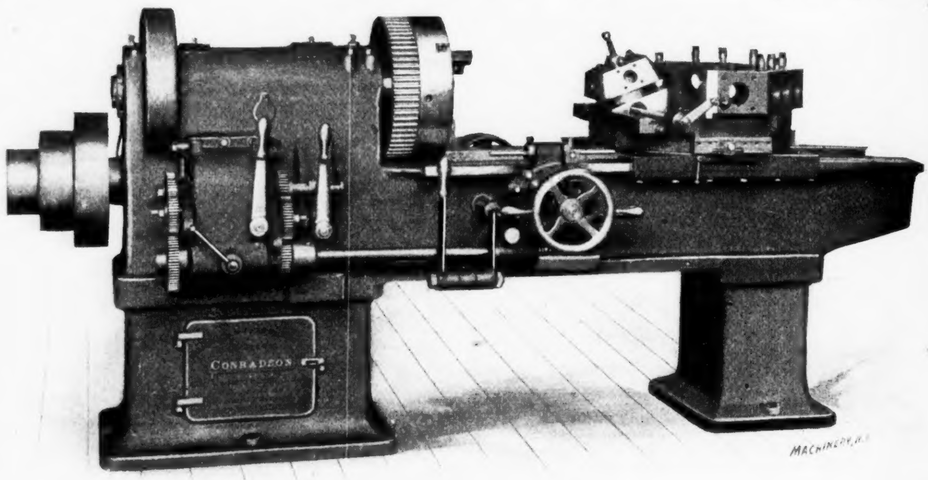


Fig. 1. Twenty-inch Semi-automatic Lathe.

In Fig. 2 is a view looking down upon the turret of a 24″ lathe and showing also the lathe and part of the feed mechanism for giving the rapid movement of the carriage along the ways of the lathe and for rotating the turret. At the back of the bed (at the right in the illustration) are three pulleys. The middle one is fast on its shaft and the outer and inner ones are loose on the shaft and carry open and crossed belts like the pulleys of a planer drive. When one or the other of the belts is shifted onto the tight pulley, by means of a belt shifter operated by a handle at the front of the machine, the shaft is given a rotary motion one way or the other, according to which belt is driving. The shaft in turn drives the large, coarse-pitch feed screw that extends longitudinally between the ways of the lathe, and the nut in which this screw turns is attached to the under side of the carriage. When the carriage is to be moved rapidly along the ways, the drive is through this mechanism; but if a slow feed is desired, the leadscrew is driven by means of bevel gears, and intermediate shaft and spiral gears from a shaft on the front of the bed. This arrangement enables the operator to control the carriage as perfectly as though moved by hand, and much more rapidly.

Motion to the turret-turning mechanism is transmitted through the shaft running parallel with the feed screw in Fig. 2 and it is driven by means of spiral gears, in a manner similar to that employed for driving the lead screw. These gears receive their motion through a pinion keyed to the hub of the inner loose pulley and run continuously as long as the belt is on this pulley.

In Fig. 3 is a view of the top of the carriage with the turret removed, and showing the mechanism for turning, indexing and clamping the turret. There are cams, *S*, directly over a vertical shaft which is driven continuously by the shaft and gearing just referred to and shown in Fig. 2. The shaft turns in the direction of the arrow and the cams can be made to turn with the shaft by a clutch mechanism which can be thrown in by the handle at the front of the carriage(shown at the bottom of the illustration). The upper cam plate carries a roller *R*, which comes in contact with the sides of the

radial slots of the disk at the center of the mechanism and turns the latter, giving the rotary motion to the turret. The mechanism is a modification of the familiar Geneva stop motion. The office of the cams is to operate the indexing slide *L* and the clamping device which holds the turret securely to its seat when the cutting tools are operating. The order of operations is first to release the turret clamps, then withdraw the indexing slide, rotate the turret, move out the index slide and finally clamp the turret.

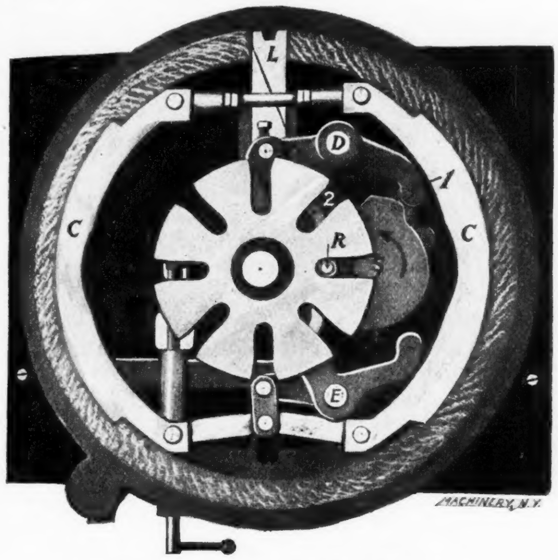


Fig. 3. Top of Carriage with Turret Removed.

The indexing slide *L* is operated through the bell crank lever pivoted at *D*. The end of the slide is notched with a V-shaped notch to fit hardened steel index pins inserted in the under side of the turret. The slide *L* is withdrawn by the cam striking at point *I* of the lever and is moved to place again by the cam coming in contact with the roll 2 on the opposite arm of the lever. The slide *L* is cut diagonally into two parts, which are connected, but between which a small amount of motion is possible. The tendency is thus to wedge the slide *L* tightly between the sides of the groove in which it slides, and so prevent lost motion.

The action of the cam plate upon the lower bell-crank lever in the operation of the clamps is similar to the action just outlined. The clamps *C C* are pivoted at their upper ends, and their lower ends are moved in or out through the action of the bell-crank lever on the toggle motion shown. The outer edges or peripheries of the clamps are grooved their whole length, with a single V-shaped groove. The lower flange, which forms the lower side of the groove of the clamp, fits under a projecting flange of the carriage, while the upper side or flange of the clamp fits over a corresponding projecting flange on the under side of the turret. When the clamp is moved out, therefore, its upper and lower flanges draw the turret flange and the flange of the carriage tightly together.

The driving gearing of the lathe headstock is shown in skeleton form in Fig. 4, and is an interesting study in mechanism. There are six changes of speed for each step of the cone, all under the control of the levers at the front of the machine, Fig. 1, and any of the speed changes can be made while the machine is in operation. The feature of the mechanism is that only one shaft, besides the spindle, is required to produce the various speed changes. The cone does not drive the spindle directly, the connection between the two always being a geared connection. The arrangement of the parts is as follows:

Cone *A* turns freely on the spindle.

Gears *B B* are attached to the cone.

Gears *D* and *E* are connected by a sleeve *F*, and all turn freely on the spindle.

Clutch *C* slides on the spindle, but has a feather which fits in a key-way in the spindle so that the clutch must turn with the latter.

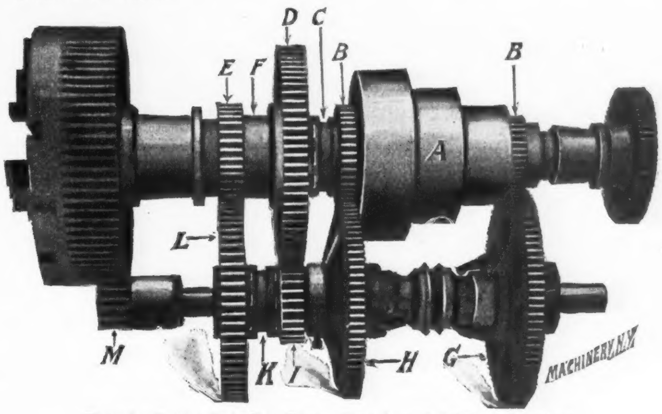


Fig. 4. Lathe Spindle, Cone, Chuck and Driving Gearing.

Pinion *I* meshes with *D*, and is fast to a long sleeve extending to the right, through gears *H* and *G*. This sleeve is loose on its shaft.

Gears *H* and *G* mesh with gears *B B*, and either can be locked to the sleeve mentioned by the friction clutches shown.

Gear *L* is loose on the shaft and meshes with *E*.

Clutch *K* turns with the shaft, and clutches with teeth in either *L* or *I* as desired.

The face plate or chuck can be driven by the pinion *M*, and the latter can be moved to the right, with its shaft, when it is desired to have it out of mesh and drive the chuck directly through the spindle. The various clutches are operated by handles at the front of the machine, within convenient reach of the operator.

The possible combinations are as follows, making six changes of speed for each step of the cone:

1.—Clutch *C* to the left, and *K* in central position; drive

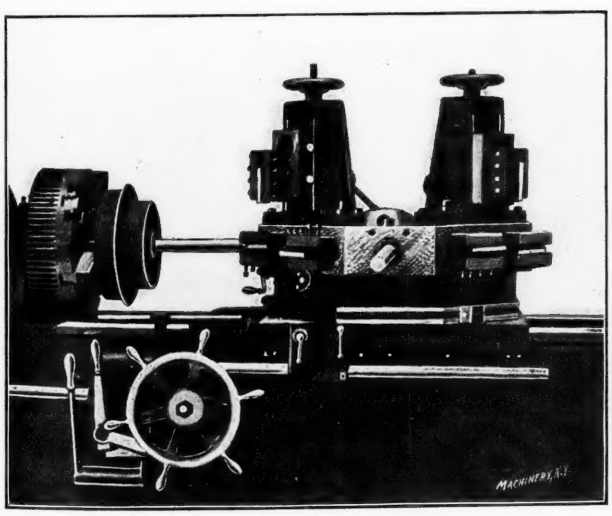


Fig. 5. Boring a Pulley.

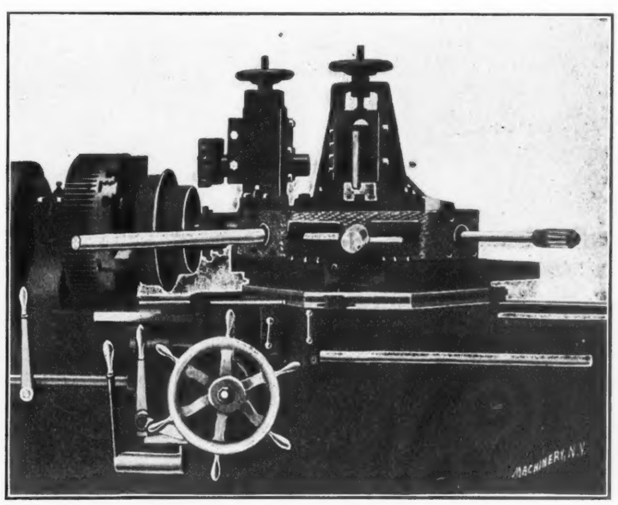


Fig. 6. Facing and Turning the same Pulley.

through B, G (or H, according to which friction is in) through the long sleeve to I, D; and clutch C to spindle.

2.—Clutch C out of mesh, K to the right and M in mesh; drive through B, G (or H) through sleeve to I and through K to shaft and thence through M to the chuck.

3.—Same arrangement, but with K to the left; drive through B, G (or H), I, D, E, L and K, to M.

The power feed mechanism of these lathes is obtained through an ingenious train of gearing inclosed in a feed box

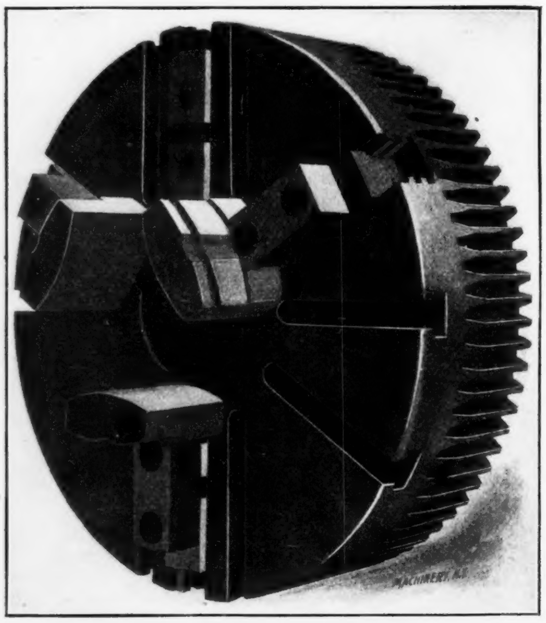


Fig. 7. Chuck with Special Jaws.

at the headstock end of the machine. Twelve changes of feeds can be obtained by the movement of levers which control sliding feathers, causing any one of a number of gears to do the driving.

Methods of Operation.

Turning from this brief description of the main features of the lathes made by the American Turret Lathe Company, we will refer to a few examples of work that the machines are capable of doing, illustrating the methods of operation as practiced at the shops of the builders.

The capacity of machines of this character depends largely upon the arrangement of the turret and the method by which the various tools are held. The turret of these lathes is low and of large diameter, and embodies features that adapt it to an unusual number of operations at one setting of the tools. There is no cross slide upon the ways of the lathe, all the tools for all purposes being carried by the one carriage on which the main turret is mounted. Referring to the plan view, Fig. 2, it will be seen that there is a cross slide mounted on the main turret, which turns with the turret and carries a small auxiliary turret capable of holding four tools. This small turret has an independent power cross feed and is designed primarily for facing or for doing other work where a cut is to be taken with a single pointed tool.

The main turret has five vertical faces, two of which are long enough for three large holes in each face for holding tools, and three of which are shorter and contain one hole each for boring and reaming tools. Fixtures or tools can also be bolted directly to any of the turret faces. On top of the two larger sections of the turret are bolted housings carrying tool slides that can be fed in a vertical direction by the hand wheels, as illustrated in Figs. 2, 5 and 6. The varied uses to which an outfit of tools can be put is indicated in Figs. 5 and 6. In. Fig. 5 a pulley is held in the chuck of the machine and is being bored. For the second operation the turret is turned two notches, skipping the left-hand set of facing tools shown in Fig. 5, bringing the boring bar that extends toward the front into position for taking the second or finishing cut. Skipping one face of the turret, as was done in passing from the first to the second boring tools is no objection with this lathe, because the turret is operated by power, and no extra effort is required on the part of the operator. After the second boring tool has passed through the pulley, the next face of the turret is skipped, bringing the reamer into position. This reamer is shown in Fig. 6. In all the boring operations, where it is feasible, the end of the boring bar passes through the hole in the casting, and is supported by a bushing inserted in a recess in the center of the chuck. The same practice is followed in turning, especially when a heavy facing cut must be taken. In Fig. 6 the tools are just approaching the position for turning. The facing cutters are advancing to the work to square the end of the hub of the pulley and true up the edge of the rim. A tool carried by the housing or bracket on top of the turret is also advancing to turn off the first pulley face, after which it will square up the flange between the two steps of the pulley. The finishing cut is taken by the set of tools appearing on the central face of the turret in Fig. 6. In this view the bar for supporting the pulley while the two facing cutters operate upon it, is clearly visible. One advantage of a tool operated by a vertical slide is that it can be raised over any projection and brought down on the other side where necessary to finish that side.

In Fig. 7 is shown a method used in these works for adapting the chuck to pieces of various shapes. This chuck is a combination universal chuck, with three jaws and a fourth independent jaw. The projecting portions of the jaw are cast-iron pieces bolted to the parts that slide in the body of the chuck. These cast-iron jaws can be made of any size or shape, and they are milled in a fixture so that they are interchangeable.

Another special arrangement is the roughing out cutter illustrated in Fig. 8. The difficulty in facing large cast-iron surfaces with a broad facing tool is in breaking up the scale. After this has been accomplished there is but little trouble in finishing the casting, even where the cut is several inches wide. The tools for this purpose, shown in Fig. 8, consist of a series of Mushet steel tools held by set screws in the slots of the four-armed holder. Where one of the

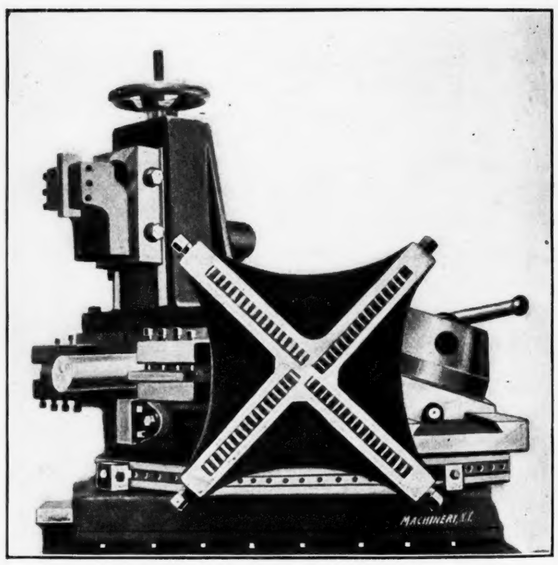


Fig. 8. Cutter Head used as a Scale Breaker.

series of tools fails to cut beneath the scale, the next one is almost certain to do so, and by the time a point on the casting has made a few turns past all four arms of the cutter, there is little likelihood of any of the scale remaining.

There are many interesting examples of work done on these machines to be seen at the works of the American Turret Lathe Company, but the illustrations given will convey an idea of the system that is followed. In future articles upon this subject methods adopted in other shops will be considered.

* * *

A test of the oil well "gusher" recently drilled at Lucas, Texas, shows it has the unprecedented output of over 70,000 barrels of petroleum per day. At the prevailing price for this grade of petroleum, the well brings the owners a revenue of $28,000 per day.

ELECTRO-MAGNETS FOR IRON-WORKING ESTABLISHMENTS.

THE LIFTING CAPACITY OF MAGNETS AND THE CONDITIONS GIVING THE BEST RESULTS.

WM. BAXTER, JR.

Electro-magnets are used to a greater extent in iron-working establishments than is generally supposed, and in the course of time many applications will be found for them that are not thought of now. As a magnet is possessed of the power of attraction, it is evident that there are many ways in which it can be made useful. In rolling mills it is used to lift large boiler plates, for which purpose it affords decided advantages over other methods. The magnets are suspended from the hooks of the lifting crane, and are so disposed that they pick up the plate at several points so as to prevent it from swinging around into contact with nearby objects, and also so as to obviate any danger of its bending under its own weight. In machine shops electro-magnetic chucks are used to hold work in planers, shapers, lathes and other tools. It is not proposed in this article to show the various ways in which magnets may be used, for these will be evident to any one who is familiar with shop requirements. It is proposed to show what magnets can do, the conditions under which they act most advantageously, and also the way in which they should be proportioned to obtain the desired results. In connection with the latter discussion we will give rules by means of which the lifting capacity can be calculated.

of current is passed through the coils *A B*. If with any of the cores, the force required to pull *K* away from the poles is measured when the two parts come into direct contact, and also when sheets of paper and cardboard of various thicknesses are placed between them, it will be found that the thicker the separating board, the lower the attractive force.

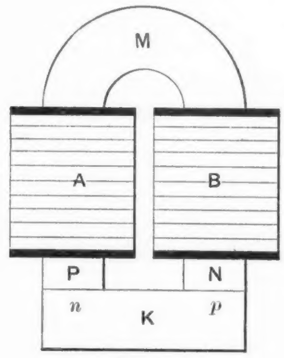


Fig. 1.

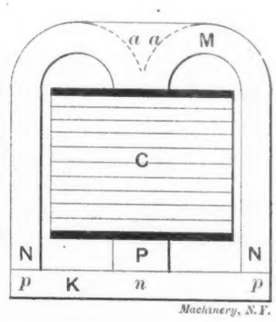


Fig. 2.

These differences in the force of the magnet due to the use of different kinds of iron or steel for the core, and also to the distance between the surface of *K* and the ends of the poles, arise from the fact that the magnetizing force of the current circulating through the coils *A B* cannot develop the same amount of magnetic force in all kinds of materials. Putting it in another way, all forms of matter resist the development of magnetic force, but they do not all resist to the same extent. This resistance that matter interposes to the development of magnetic force is called magnetic reluctance. The difference between the reluctances of the various grades of iron and steel is not very great when compared with the reluctance of other metals, or of air. The reluctance of the lowest grades of steel may not be more than ten times as great as that of the best grades of iron; that is, the best grades magnetically considered. The difference in reluctance between iron and air, however, varies between about one hundred to one, and two thousand to one, according to the intensity of magnetization. The magnetic reluctance of materials is determined experimentally, and tables are given which show the number of magnetic units that can be developed per unit of magnetizing current flowing in the magnetizing coils. The magnetizing value of the current flowing in the coils *A B* is directly proportional to the product of the strength of current in the wire by the number of turns, and this product is

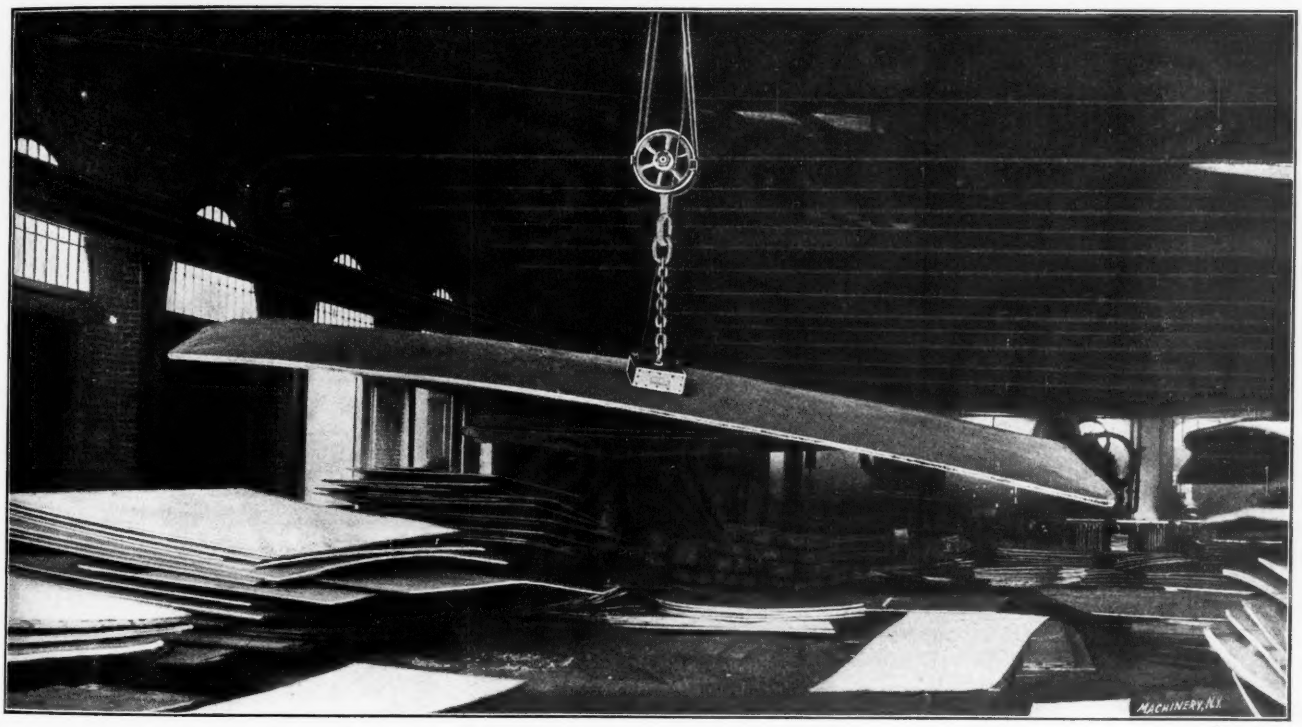


Plate Handling at Otis' Steel Works, Cleveland, O., by a Lifting Magnet made and installed by the Electric Controller & Supply Co., Cleveland.

To begin with, we may observe that magnets are only useful for handling iron or steel; they possess no attractive power toward other materials. The lifting capacity of a magnet is dependent upon the dimensions of the core, the amount of wire wound upon it, and upon the material of which the core is made. It also depends upon the size and outline of the poles.

Magnets can be made in the form of straight bars, but such a form is not advisable owing to the fact that the capacity is small compared with the material used. What is commonly called the horseshoe type, shown in Fig. 1, is the most efficient. In this figure *M* is the magnet core, and *A B* are the magnetizing coils, while *K* is the keeper, or armature. If the coils *A B* are left unchanged, and *M* is made of wrought iron, cast iron and various grades of steel, the lifting force will be different for the various kinds of metal; that is, the force required to pull *K* away from the poles *P N* will not be the same for the different metals, assuming that the same strength

expressed as so many ampere turns. For example, if the coils have one hundred turns of wire in each one, and the current strength is ten amperes, then the magnetizing value of each coil will be one thousand ampere turns; and as the two coils act to magnetize the same magnet, their total value will be two thousand ampere turns. If each magnet coil had ten turns of wire and the current strength were one hundred amperes, the ampere turns would still be one thousand per coil.

The core M and the keeper K constitute what is called the magnetic circuit. It has been determined experimentally that the ampere turns required to develop a given number of units of magnetic force per unit of cross section of the core M, is

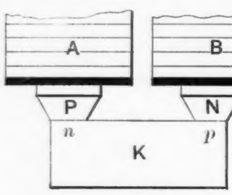


Fig. 3.

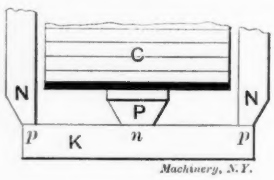


Fig. 4.

directly proportional to the length of the magnetic circuit; that is, if the length of M and K measured along the central line is doubled, the ampere turns will have to be doubled to develop the same magnetic density. If this length is reduced to one-half, the ampere turns will have to be reduced to one-half. If the cross section of M and K is increased or decreased, the number of magnetic units developed per unit of cross section will not be changed; hence, the total magnetic force, or magnetic flux, as it is called, will increase or decrease in direct proportion with the cross section of core M and keeper K. In order that the relative values of different kinds of iron and steel, and also of air, for magnetic purposes, may be compared, it is necessary to find the number of ampere turns required to develop given magnetic densities in equal length of magnetic circuits. In technical language, the centimeter is the unit of length, and the square centimeter is the unit of cross section; so that magnetization tables are worked out so as to show the number of ampere turns required to develop a given number of magnetic units per square centimeter of cross section for each centimeter of length of magnetic circuit. In table 1, P. 280, these figures are given for a cross section of one square inch, and a length of magnetic circuit of one inch. The figures in the first column are the number of magnetic units; those in the second column give the number of ampere turns required, per inch of length of circuit, to develop this number of units in a square inch of cross section, provided the magnetic circuit is wholly in air. The figures in the third column give the number of ampere turns for a circuit composed wholly of cast iron. The fourth column gives the same information for mild steel, such as is found in the ordinary sheet iron of the present day, and the fifth gives the figures for wrought iron of high magnetic qualities, such as Norway iron.

Running down the first column of table 1 until the figures 50,000 are reached, and then following this line through the other columns, we will find the figures 16,250 in the second, which means that to develop a magnetic density of 50,000 units per square inch in an air circuit, requires 16,250 ampere turns of magnetizing force for every inch of length of the magnetic circuit. In the cast iron column the figures are 160, which shows that to develop the same magnetic density in cast iron only 160 ampere turns per inch of length of magnetic circuit will be required. In the steel column we find that the figures are reduced to 16.5 ampere turns per inch of length, and in the iron column they are reduced to 9 ampere turns. Thus it will be seen that any kind of iron or steel is vastly superior to air for magnetic purposes.

From the fifth line of the table it will be seen that 8,125 ampere turns are required to develop the same magnetic density in air as is developed in wrought iron with 4 ampere turns, or about 2,000 times as many. In the last line it will be seen that the ampere turns required for air are about one hundred and fifty times as great as for wrought iron. This difference arises from the fact that the reluctance of air is constant, while that of iron and steel increases as the density of magnetization increases. Owing to this fact it is not advisable to magnetize iron or steel to a high density, as the ampere turns increase rapidly as the density increases.

Since the magnetic reluctance of air is so much greater than that of iron or steel, it can be realized at once that if any considerable portion of the magnetic circuit is air, the magnetization with a given number of ampere turns will be greatly reduced, and this explains why the force required to pull the keeper K away from the poles P N is reduced when cardboards are placed between them, for these boards are equivalent to just so much air space in the magnetic circuit. The difference in the number of ampere turns required to develop given magnetic densities in steel and iron, as given in table 1, shows why the force of the magnet is varied by making the core of different materials.

Since the introduction of a small length of air in the magnetic circuit greatly reduces the magnetic density, it follows that to obtain good results in a lifting magnet the object lifted must have flat surfaces that can be brought into close contact with the ends of the poles P N. Owing to this fact a magnet that will lift a ton if presented to a flat surface of a mass of iron, may not lift one hundred pounds if the surface of the object is very irregular; hence, magnets are of little value for lifting or holding rough castings.

It is commonly supposed by those not familiar with electrical principles that a magnet cannot have more than two poles; but this is not the case. Fig. 2 shows a form of magnet in which there are two N N poles and one P pole. In this illustration it will be noticed that the coil C is drawn of such size that it can hold as many turns as the two coils in Fig. 1. The center pole is of the same cross section as the poles in the first figure, but the side poles are of one-half the section which is all that is required, there being two of them. Both these magnets are of the same lifting capacity.

The lifting capacity of both the magnets can be increased by reducing the area of the ends of the poles, as shown in Figs. 3 and 4. This fact appears to controvert the statements made in the foregoing paragraphs, that the total magnetic flux is increased by increasing the cross section of the magnetic circuit, and decreased by reducing it. Now it is evident that if the poles are made smaller, as in these two illustrations, at that part of the magnetic circuit, the cross section is reduced, and on that account the total magnetic flux must be less than

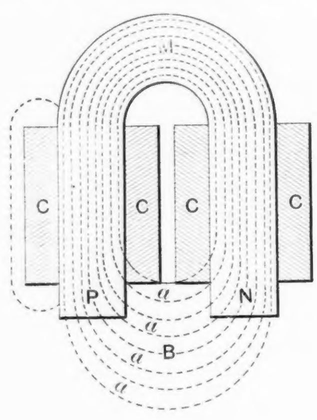


Fig. 5.

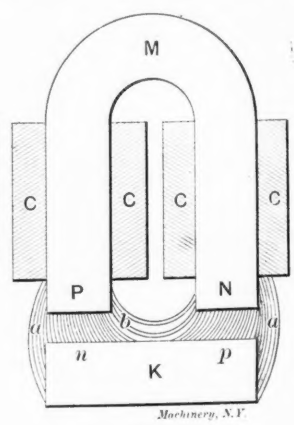


Fig. 6.

in the first two figures. This is actually the case; but for all that, the lifting power of the magnet is greater. This condition arises from the fact that the lifting power is proportional to the square of the magnetic density, and while reducing the area of the poles reduces the total magnetic flux, it at the same time increases the density through the reduced area and the gain effected in this way is more than the loss.

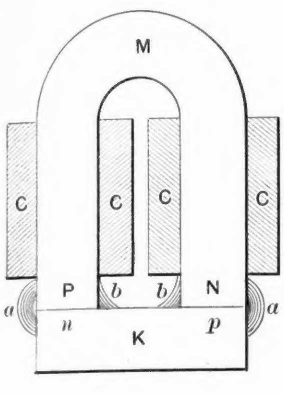
The rule for calculating the lifting capacity of electromagnets is very simple and is given in the following formula:

$$F = \frac{A B^2}{72{,}000{,}000}$$

in which F represents the lifting force in pounds, A the area of the pole piece, and B, the magnetic density; that is, the number of magnetic units per square inch of cross section

of the pole surface. **This formula gives the capacity of one pole so that for a horseshoe magnet it must be multiplied by two.**

The results obtained by this rule are true only when the poles of the magnet, and the face of the keeper *K* or other object lifted, come into as perfect contact as is possible practically. As soon as there is an air space introduced between the poles and the keeper the capacity drops off, and when this space becomes equal to the width of the pole the actual capacity will be so far from that obtained by the rule as to render the calculation of little value. This discrepancy is caused by the magnetic leakage, which is very difficult to



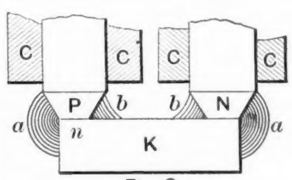


Fig. 8

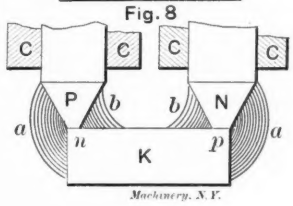
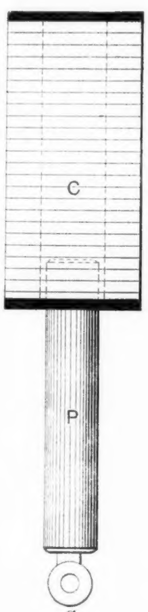


Fig. 7. Fig. 9.

calculate. The way in which it affects the case can be made clear by the aid of Figs. 5 and 6. The first one of these shows Fig. 1 with the coils in section and the keeper removed. The broken lines *a a a a a* are intended to represent the magnetic flux. As at *B* this flux has to pass through a long air gap from pole to pole, the magnetic density is greatly reduced, which we endeavor to indicate by drawing a few lines *a a a*. In Fig. 6 the presence of *K* reduces the air space in the magnetic circuit, and therefore increases the flux, but we cannot determine accurately the difference it makes, because the magnetic flux does not pass from the poles to *K* in straight



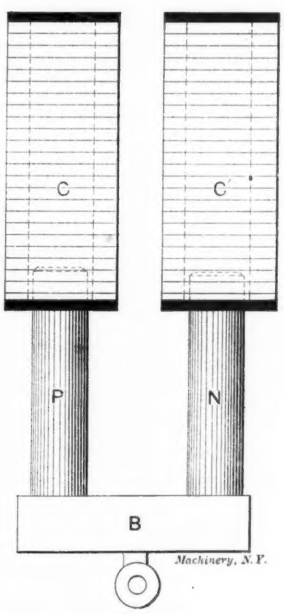


Fig. 10. Fig. 11.

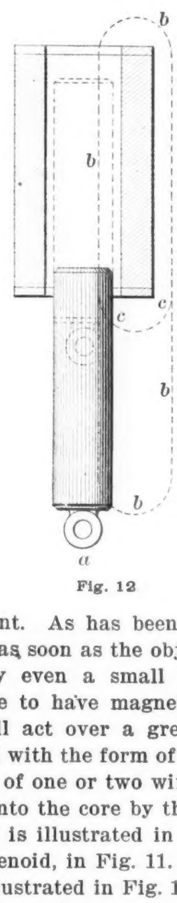
lines, but spreads out as shown at the sides by the lines *a a*, and in the center by the lines *b*. It is evident, however, that the nearer *K* is to the ends of the poles, the more nearly straight the flux lines will be.

When *K* is brought into actual contact with the poles, unless there is a perfect joint formed, the air space between the surfaces will cause some of the magnetic flux to pass around, as is illustrated at *a a* and *b b* in Fig. 7. That this leakage occurs can be demonstrated by the fact that if, after *K* is up against the ends of the poles, we place a nail near the joint, it will be attracted, and it would not be if all the force of the magnet was exerted against *K*.

The extent to which the lifting capacity of a magnet will be increased by reducing the size of the poles cannot be calculated accurately owing to the magnetic leakage. If the poles are reduced to the extent shown in Fig. 8 the leakage fringe, as it is called at *a a* and *b b*, will be greater than in Fig. 7, owing to the fact that the reduction of the area of the pole forces the magnetic flux out into the surrounding air space. If the poles are reduced to a still greater extent, as in Fig. 9, the leakage fringe will be still further increased, as shown. While we can readily see that reducing the area of the poles will increase the magnetic fringe, it is very difficult to determine to just what extent the reluctance of the magnetic circuit is increased by cutting away the corners of the poles.

Owing to the foregoing facts the calculations for determining the lifting capacity of magnets cannot be relied upon as being strictly accurate, even when the poles and the object lifted are in actual contact; for even then there will be a magnetic fringe around the joint, which will represent a considerable portion of the total magnetic force, unless the density of magnetization is very low.

Magnets of the types so far described are used for cases where it is desired to obtain great lifting capacity with small



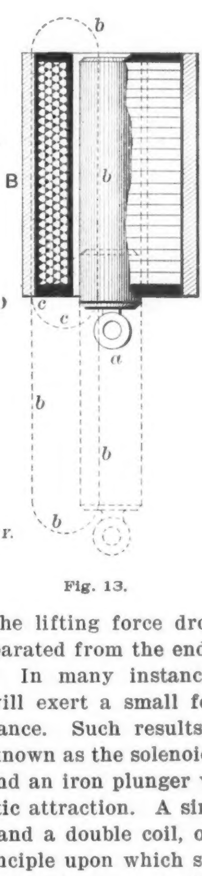


Fig. 12 Fig. 13.

movement. As has been shown the lifting force drops very rapidly as soon as the object is separated from the ends of the poles by even a small distance. In many instances it is desirable to have magnets that will exert a small force but that will act over a greater distance. Such results can be obtained with the form of magnet known as the solenoid, which consists of one or two wire coils and an iron plunger which is drawn into the core by the magnetic attraction. A single coil solenoid is illustrated in Fig. 10, and a double coil, or horseshoe solenoid, in Fig. 11. The principle upon which solenoids act is illustrated in Fig. 12. When the plunger is in the lower position, as shown, the magnetic flux developed by the coil will be located in a circuit about such as is indicated by line *b b b b*, which surrounds the side of the coil, and the entire length of the plunger. Nearly all this circuit is in air, only the portion passing through the plunger being in iron. When the plunger is drawn up to the position shown in the dotted lines the length of the magnetic circuit is greatly shortened, and the portion that is cut off is in the air part of the path; hence, the magnetic density will be greatly increased because the reluctance has been so much reduced. Thus it will be seen that when the plunger is up, the pull is greater than when it is at the lowest position, and the force increases gradually from the latter position toward the former position.

If the coil of a solenoid is encased in an iron tube, its force will be increased, and the reason why can be understood at once from Fig. 13 which shows such a solenoid. In this figure *B* represents the iron tube casing. When the plunger is in the lowest position, the air portion of the magnetic circuit con-

sists of the line *b b b b* with the exception of the portions that pass through the tube and the plunger, but when the upper position is reached the air portions of the circuit are the two end circular curves *c c*. Thus it will be seen that the solenoid, Fig. 13, is more powerful than Fig. 12, because the outside portion of the magnetic circuit runs in air in the latter, while it is in iron in the former.

Table 2 gives the lifting capacity of magnet poles, upon the supposition that the surface of the pole and that of the object lifted are in actual contact, and that there is no magnetic leakage or fringe. The first column gives the magnetic density per square inch; that is, the number of magnetic units per square inch of cross section. This magnetic density can be calculated by the aid of table 1 and of the explanations given in the opening paragraphs.

The actual capacity of any magnet pole will be somewhat less than these figures, but for densities below 50,000 it will be very little less. The allowance to be made for the loss due to magnetic leakage cannot be determined by any general rule, as it depends upon the shape of the pole and the object lifted. It can be judged with a fair degree of accuracy by an experienced design of magnets.

The size of the wire for the coils can be made at the rate of 500 circular mils cross section per ampere of current for magnets that are not in permanent use, and double this section if the current flows continuously. These figures are also only approximate and will vary with the size and shape of the magnet and the coils, and also with the depth of wire in the coil and its size.

TABLE I.

Magnetic Units per Sq. In.	Ampere Turns. Air.	Cast Iron.	Steel.	Wrought Iron.
5,000...........	1,625	3.25	3.0	1.6
10,000...........	3,250	5.20	4.0	2.2
15,000...........	4,875	6.70	5.0	2.6
20,000...........	6,500	8.00	6.5	3.5
25,000...........	8,125	10,50	7.5	4.0
30,000...........	9,750	20.00	9.0	5.0
35,000...........	11,375	38.00	10.5	6.0
40,000...........	13,000	65.00	12.5	7.0
45,000...........	14,625	110.00	14.5	8.0
50,000...........	16,250	160.00	16.5	9.0
55,000...........	17,875	300.00	19.0	10.0
60,000...........	19,500	500.00	22.0	12.5
65,000...........	21,125	......	26.0	15.0
70,000...........	22,750	......	30.0	19.0
75,000...........	24,375	......	35.0	24.0
80,000...........	26,000	......	42.0	30.0
85,000...........	27,625	......	52.0	50.0
90,000...........	29,250	......	....	90.0
95,000...........	30,875	......	....	200.0

TABLE II.

Magnetization and Magnetic Attraction.

Magnetic Units per Sq. In.	Pounds per Sq. In.	Magnetic Units per Sq. In.	Pounds per Sq. In.
82,250	14.39	96,750	129.7
6,450	.577	70,950	69.77
12,900	2.308	77,400	83.07
19,350	5.190	83,850	97.47
25,800	9.228	90,300	113.1
38,700	20.75	103,200	147.7
45,150	28.26	109,650	166.6
51,600	36.95	116,100	186.8
58,050	46.72	122,550	208.1
64,500	57.68	129,000	230.8

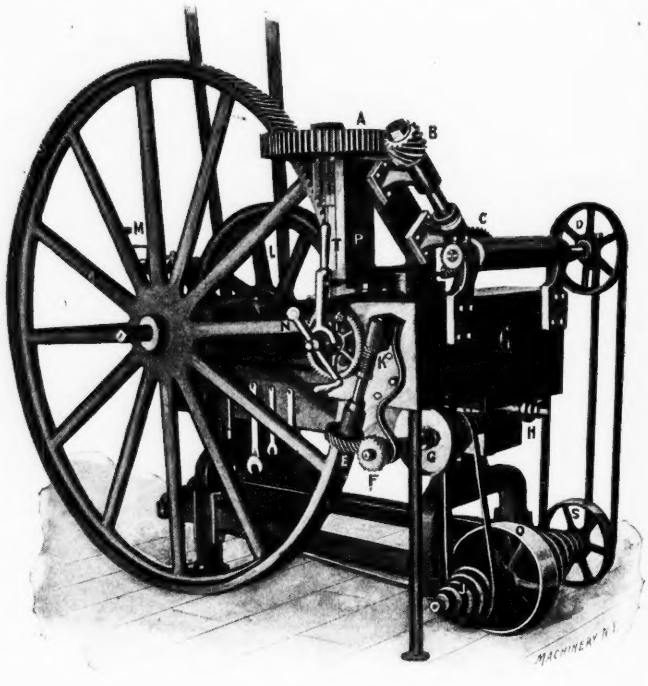
* * *

It is said that when work was closed in a mine shaft at Leadville, Colo., last year, a duplex pump at the bottom of the shaft, 400 feet below ground, was overhauled, coated with oil and left in good condition, with the expectation that it would remain under water for a considerable time. Water accumulated 80 feet deep over the pump, but when steam was raised in the boilers recently, and steam was turned on through the pump connections, the pump started at once and was soon delivering 400 gallons of water per minute. Although the steam pipe was surrounded by cold water enough steam passed through without condensation to successfully operate the pump. In two days' time the water had been pumped down to the pump station, and in three days the lowest drift was free of water.

THE ARTHUR SEVEN-FOOT GEAR CUTTER—NOVEL GEAR MODEL.

The spur gear cutter shown herewith is one of several special gear-cutting machines designed and built at the works of the Arthur Company, Front St., New York, for their own use.

The machine shown has an economical capacity for spur gears up to seven feet in diameter, 10 inches face, 1½ diametral pitch (or 2-inch circular), but larger pitches may be cut, as the machine takes an 8″ cutter. One of its distinguishing features is the spiral gear drive for the cutter, which gives it a peculiarly smooth and powerful action. The ratio between the cutter and the driving pulley, *D*, is 1 to 15 on heavy work, and 1 to 7½ on light work, change gears being provided for *A* and *B*. The view of the machine given does not show the cutter, as it is hidden by the frame, *P*, of the cross slide carrying it. It revolves in a horizontal plane, and is driven by a vertical shaft carrying at its upper end the spur gear, *A*. This gear is 18 inches in diameter, or nearly four times the diameter of the cutter used on the



Seven foot Gear Cutter at Work.

wheel being cut when the photograph was taken. The periphery of *A* being so much greater than that of the cutter in all cases, the pressure between the teeth of the driving and driven gear is low, which is one reason for the remarkable smoothness of the cutter's action on the heaviest cuts.

It will be observed that the gear, *B*, driving *A* is a 45 deg. spiral, and that *A* is a plain spur gear. In consequence the shaft carrying *B* is at an angle of 45 deg. to the vertical plane. At its opposite end is another spiral gear, having teeth at an angle of 22½ deg., which engages with a 12-tooth worm of diametral pitch. The latter is hidden by the gear case. It will be noted that the angle of the teeth in *C*, and that of the worm-teeth must be the same if one is 22½ deg., since the worm runs in a horizontal position. The worm transmits motion to *C*, and also allows it to traverse with the motion of the cross-slide carrying it. The worm is made of cast iron, as is the gear, *A*, while the spiral gears, *B* and *C*, are bronze.

The theoretical contact between the teeth of *A* and *B* is only a point, but the wear is distributed throughout about one inch of the length of the teeth of *A* and throughout the full length of B. The larger the diameter of *A*, the greater the length of contact along its teeth, until, in the case of a rack, the wear would be distributed throughout their full length, or, rather, throughout the projected length of the spiral teeth of *B*. The result is that the wear between the teeth of this form of gearing is very low, when, as in this case, the spur gear is relatively large. The same condition

exists with the worm-drive, which, combined with the feature of traversing action, makes a very satisfactory mechanical device for this purpose.

The cone-driving pulleys are underneath the machine, the belt connecting them being in a horizontal position. These cone pulleys are made up of ordinary steel-rim pulleys of the required diameters, arranged in proper order and all of them key-wayed to engage a common feather in the shaft. The set-screws are located at 90 deg. from the feather. This form of cone pulley has been found very satisfactory by the Arthur Company, and is in evidence throughout their works. They are well adapted to high-speed work, as each pulley is independently balanced, and any slight inaccuracies of balance are likely to be neutralized in the arrangement of the pulley forming a cone.

The feed cones, *G* and *J*, have six steps, and give a range of feeds of 9, 13, 19, 28, 40 and 61 turns of the cutter per inch of traverse. Motion is transmitted from *G* through the spiral gears, *E* and *F*, and thence to the worm, *K*, and the worm-wheel engaged, which is mounted on the cross-slide screw. The lever, *T*, operates a clutch to engage and disengage the feed, and arrangement is made to throw it out automatically at the end of the prescribed cross-slide traverse. As mentioned in a preceding paragraph, change gears are provided to replace *A* and *B*, giving a ratio of 1 to 7½ turns of the pulley, *D*. Since with the gears, *A* and *B*, shown, in position, the ratio is 1 to 15, it is evident that the change means multiplying the speed of the cutter by two, and some means must be provided to correspondingly increase the rate of feed in order to have the rates of feed correspond to the figures on the feed-plate. This comes about because the feed motion is taken off the cone-shaft and a change of velocity ratio in the cutter-drive does not affect that of the feed. The change is effected very neatly by simply reversing the position of the spiral gears, *E* and *F*, which bear the relation of 10 to 14, having 20 and 28 teeth. The theoretical ratio required is 1 to the square root of 2, or 1 to 1.414 +, which is very closely approximated by 20 and 28.

The depth of cut is regulated by a longitudinal screw, the squared end of which shows at *H*. An adjustable graduated dial permits all micrometer readings to be taken from zero. The slide carrying the wheel being cut, of course carries the master wheel and the indexing mechanism shown at *L* and *M*. This master wheel is 40 inches, and has 240 teeth. Wheels are generally indexed by one turn of the index handle, *M*, change gears being employed to get the required divisions.

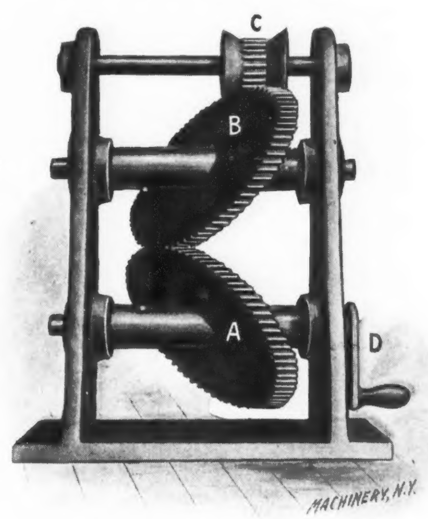
Ball-thrust bearings are used throughout the machine. The spiral gearing is in all cases arranged so that the thrust of the gear at one end of a shaft will, in a measure, be balanced by the thrust of the one at the other end. The resultant or unbalanced thrust is taken by the ball-thrust bearings.

The gear shown in the machine is practically seven feet in diameter and, therefore, it required nearly the full capacity of the machine. The teeth are 3 diametral pitch, and the face width of the gear is 4 inches. To illustrate the smooth action of the machine on comparatively heavy work, a tooth was cut in the writer's presence with a feed of nine turns of the cutter per inch of traverse, each tooth of the cutter taking a chip of about 1-100-inch in thickness. The smoothness of the action, and freedom from noise and vibration, were quite remarkable, and conclusively demonstrated the merits of spiral gearing for such machines.

AN INTERESTING GEAR MODEL.

A number of working gear models were illustrated and described in the January, 1900, issue of MACHINERY which were built at the works of the Arthur Company. These models show in an interesting manner the peculiarities of worm, spiral or helical and herring-bone gearing and have attracted considerable attention from those concerned with "gearology."

The accompanying cut shows another gear model recently added to the collection and which is far more interesting in action than in "still life." The principal feature of the model is the two gears *A* and *B* which in appearance are two elliptical gears working under the impossible condition of fixed center distances with their major and minor axes coinciding. These gears rotate at the same velocity ratio and *B* drives a third spur gear, *C* having flanged sides. The gear *C* is not only rotated but is reciprocated back and forth along its bearing, engaging the sides of its driving gear. It is, of course, obvious that the "elliptical" gears are in reality swash-plates or spur gears formed as a diagonal slice from a spur gear



Model having Swash-plate Gears.

having a length equal to the elliptical section projected on its axis. It will be observed that the teeth are cut parallel with the shafts and all are the same distance from their respective centers, so that the paradox is one of appearance only.

When the gears are turned by means of the handle *D*, the action of the model as a whole, to say the least, is quite "hilarious."

* * *

What James Watt was to the steam engine and its development Dr. N. A. Otto was to the gas engine and its development. Previous to Watt's time much work had been done upon the steam engine, but to Watt is due its successful introduction into the commercial world. Much had also been done in developing the gas engine, and the Frenchman, Beau de Rochas, was the first to suggest the now generally adopted "four cycle" system, but it was only through the efforts of Otto that it was brought to light and made a commercial success. In a paper contributed by John Salter, Jr., to the *Journal of the Am. Soc. of Naval Engineers* the author thus explains the relative importance of the work of Otto and Beau de Rochas: "Their relation is much the same as that between Lief Erickson and Columbus. Columbus discovered America; that is, he uncovered it, and in uncovering America to the world he uncovered or discovered Lief Erickson, who had previously landed on this continent, and made him famous. In exactly the same manner Dr. Otto invented or discovered the Otto 'four cycle,' and in doing so he uncovered and made famous Beau de Rochas."

* * *

Theoretically, the resistance of a vessel driven through water changes as the square of the velocity, and the power required to drive it, as the cube of the velocity. Thus if the velocity of a ship is increased from ten to twenty knots per hour, the resistance would be four times as great, and the power required to drive it eight times as great as at the ten-knot rate. This is independent of what is known as "skin friction." The reason for the great increase of power required when the speed is doubled is that the particles of water are crowded away by the vessel two times as fast, and consequently the resistance is quadrupled. The same work being done in one-half the time as before, the power is, of course, doubled, making the power required eight times that for the ten-knot rate, as before stated.

Entered at the Post-Office in New York City as Second-class Mail Matter.

MACHINERY

A practical journal for Machinists and Engineers, and for all who are interested in Machinery,

PUBLISHED MONTHLY BY

THE INDUSTRIAL PRESS,

9-15 MURRAY STREET, NEW YORK CITY.

CHICAGO OFFICE—1505 MANHATTAN BUILDING.
PHILADELPHIA OFFICE—MACHINERY FLOOR, THE BOURSE.
NEW ENGLAND OFFICE—620 ATLANTIC AVE., BOSTON.

ONE DOLLAR A YEAR, POSTAGE PREPAID, TEN CENTS A COPY.
FOREIGN SUBSCRIPTIONS ONE DOLLAR AND FIFTY CENTS A YEAR.

Lester G. French, Editor.
Fred E. Rogers, Associate Editor.

The receipt of a subscription is acknowledged by sending the current issue. Remittances should be made to THE INDUSTRIAL PRESS, and not to the Editors. Money enclosed in letters is at the risk of the sender. Changes of address must reach us by the 15th to take effect on the following month; give old address as well as new. Domestic trade is supplied by the American News Company or its branches.

We solicit communications from practical men on subjects pertaining to machinery, for which the necessary illustrations will be made at our expense. All copy must reach us by the 5th of the month preceding publication.

FOREIGN SUBSCRIPTIONS MAY BE SENT TO THE FOLLOWING FIRMS:

AFRICA—Cape Town: Gordon & Gotch.—Johannesburg: Sherriff Swingley & Co.
AUSTRO-HUNGARY.—Vienna: White, Child & Beney; Lehman & Wentzel.—Budapest: Ormai & Co.; Jos. Schvarcz & Co.; Szekely & Kaldor.
AUSTRALIA.—Adelaide, Victoria: W. C. Rigby.—Brisbane, Queensland: Gordon & Gotch.—Melbourne, Victoria: Gordon & Gotch.—Townsville, Queensland: T. Willmett & Co.
BELGIUM.—Antwerp: L. Vestrepen-Eliaerts.—Brussels: Librarie Castaigne, Montagne aux Herbes Potageres, 22.
CHINA.—Hai Phong, Tonkin, Indo-China: E. C. Chodzko.
DENMARK.—Copenhagen: V. Lowener.
EGYPT.—Alexandria: G. Artuso Molino.
FRANCE.—Paris: Boyveau & Chevillet, 22 Rue de la Banque; Ad. Janssens, 16 Place de la Republique; Fenwick Freres & Co., 21 Rue Martel.
GERMANY.—Berlin: F. A. Brockhaus, 14 Oberwallstrasse, W.—Garvin Machine Co., 17 Burgstrasse, C.—Schuchardt & Schutte, 59-61 Spandauerstrasse, C.—Dusseldorf: de Fries & Co., Actien-Gesellschaft.—M. Koyemann.—Mulhouse: H. Stuckelberger.
HAWAIIAN ISLANDS.—Honolulu: Hawaiian News Co.
HOLLAND.—Amsterdam: Peck & Co.—Rotterdam: H. A. Kramer & Son.
INDIA.—Calcutta: Thacker, Spink & Co.
ITALY.—Rome: Giorgi, Arabia & Co.
JAPAN.—Nagasaki: Lake & Co. Yokohama: Andrews & George.
JAVA.—Tegal: W. J. Amons.
MEXICO.—City of Mexico: F. P. Hoeck.
NEW ZEALAND.—Aukland: J. Flynn.
NORWAY.—Christiania: C. S. Christensen.
RUSSIA.—Moscow: J. Block & Co.; Mellier & Co. St. Petersburg: Wossidlo & Co.; F. de Szczeyanski; Carl Ricker.
SWEDEN.—Stockholm: B. A. Hjorth & Co.—V. Lowener.
SWITZERLAND—Zurich: Mayer & Zeller.
TURKEY.—Constantinople: V. L. Levy.
UNITED KINGDOM.—Sampson Low, Marston & Co., St. Dunstan's House, Fleet Street, London, E. C.

MAY, 1901.

CIRCULATION STATEMENT

MACHINERY has the largest paid circulation in its field in the world. It reaches all classes — journeymen, foremen, draftsmen, superintendents, employers; and covers the machinery field thoroughly. The regular editions of MACHINERY for the past twelve months are given below, and any advertiser in the paper will be afforded every facility to verify the correctness of these figures:

1900.		1900.		1901.	
June	27,500	November	25,000	March	30,000
July	22,000	December	27,500	April	26,000
August	21,500	1901.		May	26,500
September	21,750	January	27,500		
October	24,000	February	26,500		

Draftsmen or others who have material suitable for the data sheets issued with the quarterly numbers of MACHINERY are requested to submit it to us with a view to publication. Matter is preferred that is not to be found in the engineers' hand-books, and it should be of a general character, useful to our readers as a whole, rather than relate to special subjects in which only a few would be interested. Data in the form of tables, diagrams or concise notes are acceptable if of the character mentioned.

* * *

It is sometimes asked whether it is possible to pass a plug gage into a ring gage, the internal diameter of which is exactly the same as the outside diameter of the plug, both being of the same temperature. A novice has difficulty in fitting together and taking apart gages with differences of a 1-10,000 part of an inch, but those who make gages and have had experience in handling them are able to fit a plug into a ring of its own diameter, as nearly as it is possible to measure. This leads to the conclusion that it may, after all, be possible to accomplish the result of having two things in the same place at once, viz., the outside surface of the plug and the inside surface of the ring gage. This is not so unreasonable as at first might seem, for we are here dealing with *surfaces*, and a surface, according to its definition, has extent, but no thickness. The question seems to resolve itself to this—Can two surfaces, having no thickness, occupy the same place at once? And if they can and it were possible to make the gages with absolutely smooth and true surfaces, would the gages adhere one to the other, when placed together?

* * *

TWO EFFECTS OF MACHINERY.

The first and immediate effect of the introduction of machinery is to displace labor. It compels a certain number of people to either remain idle or to seek employment elsewhere in other departments from those in which they have been trained. It is this effect, felt personally by the workmen connected with the industries in which the machines have been introduced, that has in times past led to the opposition to machinery, especially in the early part of the last century.

The first effect, however, is not lasting and the second and ultimate effect of machinery is the expansion of labor. It seems to be wrong in principle for a body of intelligent men to be employed in slow and arduous labor when, by the introduction of machinery, a fewer number of perhaps less intelligent men can do the work quicker and easier. An automatic machine may throw out of employment a certain number of individuals at one particular place, but in the long run we doubt if any automatic machine ever resulted in the employment of fewer people, taking the country at large. On the contrary, machinery makes necessities out of luxuries, and tends to increase the per capita consumption of every desirable article, often many times; this in addition to the work required to build the machines themselves.

This view is amply sustained by the best available statistics. There has been a regular increase in the number employed in manufacturing and in the industries dependent upon machinery, in proportion to the total population. During the 30 years from 1860 to 1890, the population doubled, or increased 100 per cent., while the number employed in the industries increased 172 per cent. It would be unfair not to attribute part of the increase to the influence of machinery.

Take the case of manufacturing toothpicks. We have seen it stated that 95 per cent. of the toothpicks made in this country are from lumber cut in the state of Maine, yet only about 100 persons are employed in the industry in that state, due to labor-saving machinery. To manufacture the millions of toothpicks that Americans imagine they require would give employment to thousands if they were made by hand. But has toothpick machinery actually displaced hand-labor? If the purchasers of toothpicks had to pay the price of hand-made toothpicks, the demand would drop so suddenly that there would be an exodus of these employees from the state of Maine such as has never been seen. As long as toothpicks are cheap, they will be bought and the 100 employees thereby benefited. Let better machinery be introduced and it would in all probability result in lower prices, increased sales and the employment of the same or a greater number. Should it happen, however, that some of these 100 men were finally displaced, the growth of industries in other directions, as the direct result of machinery, and made possible only by machinery, would give them employment. In view of the statistics quoted above, moreover, it is not unreasonable to suppose that some of these men might have sufficient resources to develop other lines of work calling for the employment of others; and in fact this is what does happen, speaking in a general way.

It is not easy to outline all the effects that have been wrought by the introduction of machinery. It is futile to argue that people are either more or less happy than they were before its introduction. People lived contented lives 100 years ago, in spite of many hardships, but their desires were fewer and their expectations less than now. Whether people are happier now, we do not know; but it is certain that they could not contend with the present day complexities without the aid of machinery. Machinery is a necessity and we should not only make the best of it, as some would say, but should try to make the most of it.

* * *

Do not try to perform two experiments at once. If you are planning to make two changes in the plant or to carry out two new ideas, try one at a time and then you can tell what the effect of each is.

NOTES AND COMMENT.

The preliminary work toward stretching the great cables of the new East River Bridge was accomplished April 9, when three wire ropes, each 2½ inches in diameter, were reeled off from a scow and allowed to sink to the bottom of the river. They will be raised so that the lowest point will be about 168 feet above the river. They are to be used as the support for a working platform for the construction of the main cables. Another cable of the same size will be stretched, making four in all to support the temporary structure. It will probably take about three months to get the temporary structure completed so that work on the main cables may be gegun. These will be made up one strand at a time in the most careful manner possible.

According to the *American Engineer*, a new system for utilizing the exhaust steam from the air pump of a locomotive for the purpose of heating passenger trains is being applied to locomotives on the Maine Central Railroad, and is also used on other New England roads. The system is simple, consisting of a three-way cock attached to the exhaust pipe immediately in front of the pump and operated by a lever to which is attached a reach rod that passes into the cab to the engineer. Of the two pipes issuing from the three-way cock, one is connected by the ordinary exhaust pipe to a jacketed reservoir about 40 inches long and 20 inches diameter, hung beneath the cab. The second exhaust pipe is connected with the smokestack. The outlet pipe to this reservoir is at the rear end near the bottom and is connected to the train steam pipe by means of a flexible hose connection. The question of back pressure and its interference with the action of the air pump does not appear to be serious. With the common pressure of 200 pounds in the boiler the pump can be easily operated against the back pressure of 20 or 30 pounds usually required, and it is stated that the Maine Central have carried 65 pounds back pressure when needed.

SUPERHEATED STEAM.

On the evening of April 2 the last Junior meeting for this season was held at the rooms of the American Society of Mechanical Engineers. The paper was by E. H. Foster upon superheated steam. The author has devoted several years to engineering work abroad, and has made an extended study of the use of superheated steam by foreign engineers. Among those who took part in the discussion was John W. Lieb, manager of the New York Heat, Light and Power Co., who has visited many of the leading power plants in England and on the Continent, and incidentally investigated the application of superheated steam. The substance of the testimony of these two gentlemen is that the use of superheated steam for important power plants in England and on the Continent is becoming the prevailing practice; that it effects large saving in fuel; that the superheaters have proven durable, and that American engineers are not in accord with advanced practice through their failure to take advantage of this source of economy.

Mr. Foster attributed the prejudice against superheated steam in this country to the influence of experiments made by Isherwood about 1850. His conclusions were unfavorable to superheated steam because he believed superheaters would not prove durable; that they would be too cumbersome for marine use; that it was not possible to properly lubricate the cylinders of the engines, and that the packing would give trouble. In England and on the Continent, on the other hand, poppet valves have been in extensive use (instead of the American Corliss valve) which do not require lubrication and thus give less trouble with steam of high temperature. The way was therefore paved for superheated steam as soon as practical superheaters were placed on the market. The most common form of superheater is of cast iron pipes with annular webs on the outside to better absorb the heat. Mr. Foster personally knows of installations where these have been in constant use for from six to ten years, and apparently are in as good condition as ever.

As far as lubrication is concerned conditions are much more favorable now than fifty years ago, when Isherwood made his experiments. Then only animal oils were available, while mineral oils are now produced requiring temperatures higher than 500 or 550 degrees, the usual temperature of superheated steam, to vaporize them. These oils are successfully used for gas engine lubrication, where the temperatures are very much higher than with superheated steam. Metallic packing has also displaced the inferior packings of Isherwood's day. Mr. Foster quoted a test upon an 800 horse power plant where only 10.8 pounds of steam were used per horse power per hour, and said that he expected a consumption of only 10 pounds to be soon realized. He thought this could be achieved with compound engines, since there was but little if any gain in employing three cylinders with superheated steam. In water tube boilers of the Babcock and Wilcox type superheaters are located above the top row of tubes at the back end of the boiler and below the drum. With cylindrical boilers they are placed against the back wall of the setting.

A RIVAL OF THE TAYLOR-WHITE STEEL.

Several months ago we published an article about the Taylor-White tool steel, the process for making and hardening which is controlled by the Bethlehem Steel Company, South Bethlehem, Pa. The properties of this steel are so remarkable that it can be successfully used at much higher cutting speeds than the best brands of ordinary steel, the correct speed being that which makes the tool red hot when running dry. Information is now at hand concerning a steel of a similar character manufactured by Gebr. Bohler & Co., Vienna, Austria. This steel is known as the "Bohler Rapid," and in a circular describing it the statement is made that the steel will keep its cutting edge without being cooled, even when the tool becomes red hot through working at the cutting speed of 190 feet per minute on mild steel or iron, with a feed of ⅛ inch and a depth of cut up to 3-16 inch. When the tools become dull they need regrinding only, and do not require rehardening until the forged and hardened part is wholly used up. Figures given state that high carbon steel, with .5 to .8 carbon and a tensile strength of 37 to 56 tons, can be cut at a speed of 15 to 20 feet per minute; mild steel of .1 to .3 carbon, with a tensile strength of 28 to 34 tons, at a speed of 66 to 190 feet; castings at a speed of 39 to 98 feet; bronze at a speed of 131 to 196 feet, and brass at a speed of 164 to 196 feet per minute. At present this steel is turned out only in the form of hardened and tested planer and lathe tools ready for use, and since it is not desired to communicate the process of hardening at present, these tools must be returned when they need to be rehardened and reforged. For this reason the steel has not yet been introduced in America. In a letter written us by the manufacturers they say that they have found their steel superior to the Taylor-White steel under actual test made at the Audritz engine works, near Gratz, Austria. But few particulars are given, however, and it will be interesting when there is an opportunity to test the two steels side by side in this country, enabling Americans to draw their own conclusions.

AN APPLICATION OF INERTIA.

A problem in pumping machinery has been to use steam expansively without a fly-wheel to store energy sufficient to carry the piston to the end of the stroke. When pumping water the resistance is practically the same throughout the stroke, but if the steam is cut off much before the end of the stroke some mechanical expedient must be provided to finish it, otherwise the pump must stop. With an air compressor the conditions are still more unfavorable, since the resistance increases as the air piston approaches the end of its stroke. The consequent result is that with any ordinary direct-acting air compressor, such as the air pump of a locomotive, the steam is used full stroke which prohibits any economical performance. At the recent Richmond meeting of the Institute of Mining Engineers a paper was read descriptive of the d'Auria air compressor, in which is a "hydraulic compensator" to enable steam to be used expansively in a direct-acting pump without the use of a fly-wheel. The principle of the hydraulic compensator referred to is the same in effect as the balance wheel of a watch, a column of water being thrown to and fro by the action

of a supplementary piston between the air and steam ends of the pump, which absorbs energy at the start and gives it up during the completion of the stroke. During the first portion of the stroke the surplus energy of the steam is stored in moving the column of water which circulates through the base of the pump. This column as it is displaced on one side of the supplementary piston fills the space left on the opposite side so that as the motion begins to slacken, due to increased resistance and lessening steam pressure, it surges against the piston and enables the completion of the stroke. Besides enabling steam to be used expansively, the hydraulic compensator has the effect of so balancing the reciprocating parts that when running at 340 strokes per minute the vibration of a duplex compressor is said to be practically imperceptible. A sectional cut, with description, is given in the April issue of *Steam Engineering.*

* * *

OBITUARY.

Ulrich Eberhardt.

Ulrich Eberhardt, of the firm of Gould & Eberhardt, Newark, N. J., died at his home in that city on March 31. Mr. Eberhardt was born in Switzerland, and in the early fifties his father decided to come to this country with his family. After a hard trip to the sea coast by wagon conveyance the family sailed from Havre. The trip consumed forty days. They came directly to Newark, and the boy Ulrich was sent to work as an apprentice at the works of Ezra Gould. Besides learning the machinist's trade he had also to learn the English language, which he did at evening school; but in spite of this drawback he was later promoted to the position of foreman, and shortly afterward obtained an interest in the business, which thenceforth went under the firm name of Gould & Eberhardt. About fifteen years ago Mr. Gould retired, and a short time ago the business was incorporated in New Jersey, but the firm name was retained. Mr. Eberhardt was president of the company and held the controlling interest. His death, however, will not affect the business of the firm, which will be continued on the same lines as in the past.

The products of the firm of Gould & Eberhardt have been designed along original lines under the direction of Mr. Eberhardt, and have always had a wide reputation among the builders of machinery. This firm was the first to engage in machine tool building in Newark, and was one of the first to build milling machines and gear cutters in this country, and their machines differed radically from those developed in other sections. Certain features incorporated in these earlier machines—such, for example, as the dividing mechanism of the gear cutters—have since become the ruling practice among all makers. Many of Mr. Eberhardt's early associates are now foremen in the shop, having been connected with the works for twenty or twenty-five years. He is survived by his wife and five children and a brother, Henry E. Eberhardt, who has been associated with him in building up the business.

* * *

One who says that theory and practice do not agree usually knows little about theory or has had no experience with practice. No theory is correct unless it includes the results of practice, and a correct theory will conform to practice unless practice is wrong.

TOOLS FOR INTERCHANGEABLE MANUFACTURING.—1.

SIMPLE AND INEXPENSIVE DRILL JIGS.

JOSEPH VINCENT.

In this and other articles that may appear under this heading, it is the intention of the writer to illustrate and describe various practical points about the design and construction of jigs, tools, and fixtures used for the duplication of machine parts, and to show how unnecessary work and expense may be avoided. Particular attention will be paid to drill jigs and fixtures where the work to be machined is located and fastened within them.

We will first take up a comparatively simple class of drill jigs, used for the machining of parts where great accuracy is not required. The main point always to be considered with tools of this class is the degree of accuracy necessary for the work that is to be machined. With this point constantly in mind, much unnecessary labor and expense may be avoided.

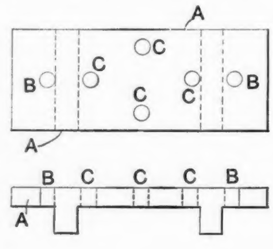


Fig. 1.

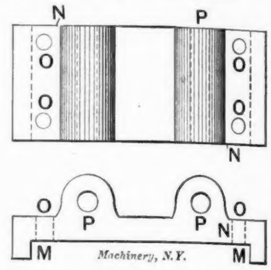


Fig. 2.

In Fig. 1 is a plain casting, with two ribs cast on one side. This casting is first planed on the sides *A A*, and a cut is also taken off the ribs. It is then ready to be drilled. As the holes to be drilled are clearance holes for bolts and studs, no great accuracy in the jig is required. The jig for this casting is shown in three views in Fig. 3, and, as will be seen, is about as simple and inexpensive to construct as could be devised for the work. It consists of one body casting, *D*, with six projections on one side for the locating points and fastening screws. It is first planed on the top, and then strapped on an angle plate on the miller table, and the inside is milled. The inside of the projections *F* and *E E* are finished square with each other, as these are the locating points. Holes are then drilled for the setscrews *J* and *I I*, in the lugs *G G* and *H*, respectively. These screws are casehardened. In locating

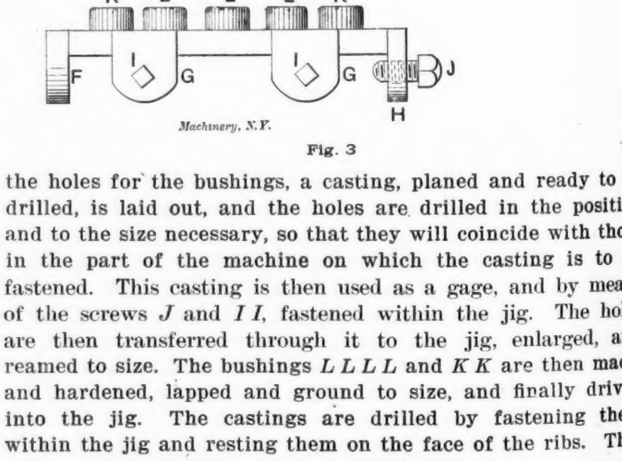


Fig. 3

the holes for the bushings, a casting, planed and ready to be drilled, is laid out, and the holes are drilled in the position and to the size necessary, so that they will coincide with those in the part of the machine on which the casting is to be fastened. This casting is then used as a gage, and by means of the screws *J* and *I I*, fastened within the jig. The holes are then transferred through it to the jig, enlarged, and reamed to size. The bushings *L L L L* and *K K* are then made, and hardened, lapped and ground to size, and finally driven into the jig. The castings are drilled by fastening them within the jig and resting them on the face of the ribs. This jig is easy to handle, and is a rapid producer.

The jig used for drilling the holes *P P* and *O O*, in the

casting Fig. 2, is of a different type, known as a box jig. It is in design one of the simplest and most reliable of jigs suitable for drilling work of the class shown, where holes have to be drilled at right angles to each other. The casting Fig. 2, is machined at one point only, *M M*, before drilling, by means of a gang mill, the size being exact and the end square. This milled surface is utilized as a locating point for the work when being drilled. The jig, Fig. 4, is in two parts—the body or box casting *A*, and the lid *E*. The body casting is first planed square on all sides, and the inside at *C C* finished off to fit the milled portion of the casting at *M M*. A cut is also

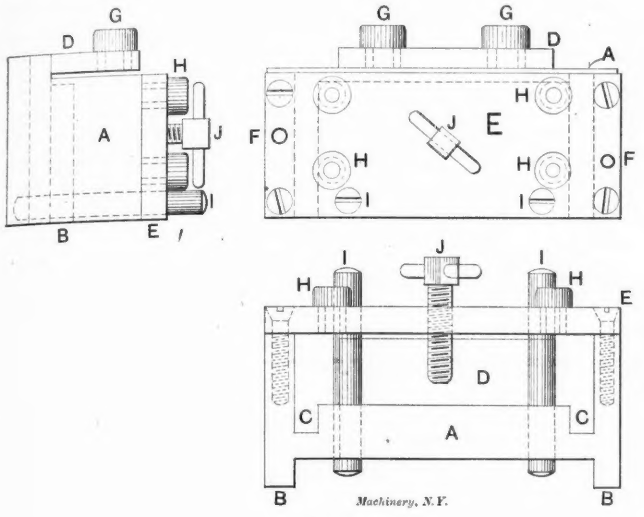


Fig. 4.

taken off the back at *D* for the sideway locating point for the work. The lid *E* is fastened to the body casting at each end by means of the screws and dowel pins. Two holes are then drilled and reamed through the lid *E*, and the base *A* for the taper locking pins *I I*, which are of Stubs steel and are milled flat on one side and hardened. The centers for the two bushings *G G* on the side of the jig, and the four, *H H H H*, on the lid, are accurately located by setting the jig on the surface plate, and locating the centers by the use of a Brown & Sharpe height gage. The centers are then prick-punched, and circles —of the diameter to which the holes are to be finished— struck around them with the dividers. Now, when holes are to be bored the exact distance apart—that is, to the smallest possible fraction of an inch—the only way to accomplish this successfully is to strap the jig on the faceplate of the lathe, and accurately locate the centers by means of an indicator. But in a jig where a limit of error is allowed, as in this case, simple and more expedient means may be used. The best and most reliable way is to strap the jig on the table of the miller and fasten the drill in the spindle chuck. The holes can then be drilled true and central—to all necessary accuracy—by running the drill in and then moving the table forward or backward, or raising it the proper distance, by means of the dial on the feed screws. In fact all bushing holes in jigs of this kind should be drilled in this manner, and not on the drill press, as it is pure luck when satisfactory results are attained with the latter method, and that factor is a poor and unreliable one to depend on. After the bushings are made, hardened and driven into their respective positions, as shown, and the clamping screw *J* made and entered into the lid *E*, the jig is complete.

To operate, the casting Fig 2 is slipped into the jig so that the points *N N* are located at *G G* in the jig. The clamping screw *J* is then tightened and the two taper pins entered with the flat face of each against the work, and each given a sharp blow with the hammer, to locate and hold the work tightly and positively in position. The jig is then stood up on the legs *B B*, and the four holes *O O O O* are drilled. It is then turned on its side, and the two holes, *N N*, Fig. 2, are drilled. The clamping pins *I I* are driven out, and the screw *J* loosened, the finished work removed and another casting inserted instead. The use of the taper locking pins *I I*, as shown, is one of the quickest and most positive means for the fastening and locating of work of the class here mentioned.

The two jigs above described embody in design and construction a number of different practical points which can be adapted for use in jigs, for the drilling of parts which have first been finished at one or more points, as well as rough castings which have not been finished at all before being drilled. Of course, for this class of work—except in special cases—jigs of the simplest and most primitive design are all that is necessary, and they are not worthy of a detailed description.

Fig. 5 shows a casting used as a leg of a small automatic machine, and the jig for drilling the holes in this casting is of a trifle more accurate and complicated design than the two previously shown, as the holes drilled in the bosses *A*, *B*, *C*, *D* are for shafts, and must be exactly the proper distance apart for the gears, which are afterward assembled on the shafts, to mesh properly. The casting Fig. 5 is first machined to size at four points, namely, at the top and bottom and both sides of the bosses. In all there are sixteen holes to be drilled, in positions shown.

The jig used in drilling the holes is illustrated in three views in Fig. 6. These show clearly the design and construction, and very little description is necessary. The jig proper, *A*, is of the box type, and is made with a removable lid, *D*. It is cast with legs at three sides—namely, at both ends, at *B*, *B*, and at the bottom at *C*, *C*. All sides are first machined square. On the inside of the jig, at *E*, *E*, *E*, *E*, are raised spots for the work to rest on. This allows of quickly finishing the inside, by merely milling the face of the spots to the height desired. The locating points for the work are four: The two adjustable locating screws, *H*, *H*, which are equipped with jam nuts, *I*, *I*, and the points at *S*, *S*. The adjustable screws should always be used when castings of the kind shown are to be drilled, as any variation in the different lots of castings may be quickly accommodated by adjusting the screws. For locking and fastening the work against the locating points and within the jig, two setscrews, *K* and *M* respectively, and the eccentric clamping lever *J*, are used. The setscrew *M* holds the casting squarely on the raised spots in the jig, and that at *K* forces it against the points at *S S*; while by giving the lever *J* a sharp turn, it forces the casting against the screws *H H*, and locks it in position, thereby holding the work securely without danger of loosening while being drilled. The eccentric clamping lever is rapid in both fastening and releasing the work. The lid *D* is located on the jig by means of the dowel pins *G G*, as shown in Fig. 7, and fastened securely by the swinging clamps *L L*.

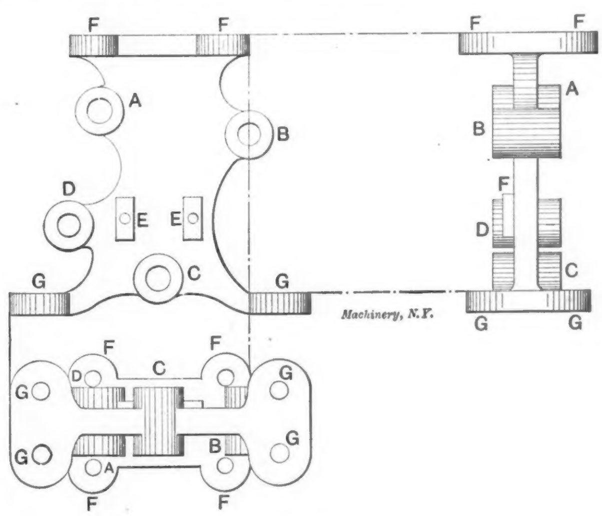
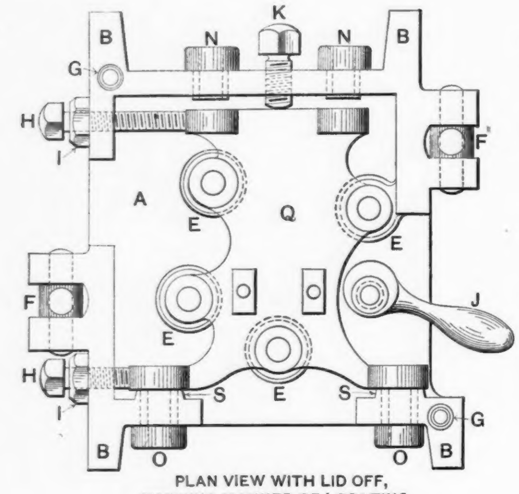


Fig. 5.

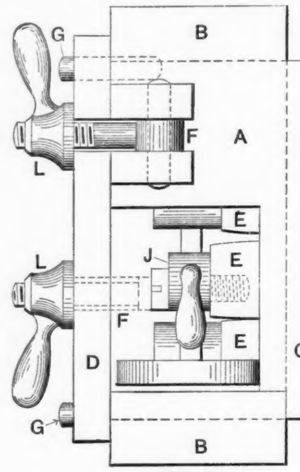
The most essential points necessary to the successful designing and construction of jigs of this type are as follows: First, in making the patterns, leave openings at all points wherever possible, for the escape of the chips and dirt; also provide spots for locating and resting the work against, so as to allow of their rapid surfacing; lastly, so design the jig as to allow of the rapid fastening of the work, and its removal when finished, as this is one of the chief factors in the operating of these tools.

When constructing (after machining the jig at all outside

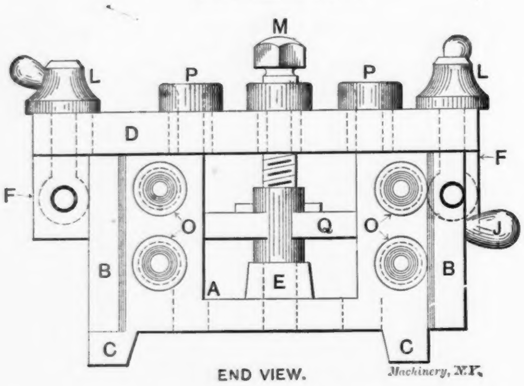
points), choose the most reliable points for locating the work. First, a machined surface for the positive locating, and then those points in which the minimum of variation is to be expected in the castings, as shown in the plan view of Fig. 6. Then, in fastening the work within the jig, use means which will be the quickest in operation, consistent with all possible simplicity.



PLAN VIEW WITH LID OFF, SHOWING MANNER OF LOCATING, AND HOLDING WORK.



SIDE VIEW.

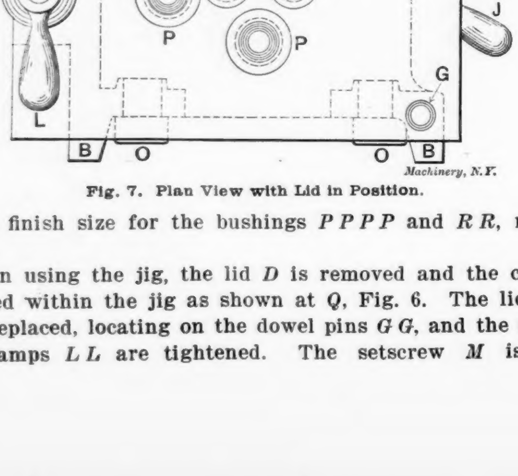


END VIEW.

Machinery, N.Y.

Fig. 6.

In this jig the holes for the bushings at either end, for drilling the holes marked *G* and *F* respectively in the work Fig. 5, are drilled in the milling machine in the same manner used for the other jigs. But for the shaft holes *A*, *B*, *C*, and *D*, after the center points are accurately located, the lid *D*, Fig. 7, is strapped on the lathe faceplate, and each center positively located with an indicator, and then bored and reamed



Machinery, N.Y.

Fig. 7. Plan View with Lid in Position.

to the finish size for the bushings *P P P P* and *R R*, respectively.

When using the jig, the lid *D* is removed and the casting inserted within the jig as shown at *Q*, Fig. 6. The lid *D* is then replaced, locating on the dowel pins *G G*, and the swinging clamps *L L* are tightened. The setscrew *M* is also tightened, and the eccentric lever *J* given a sharp turn, to locate the casting tightly in position. The holes at either end are drilled by resting the jig on the legs *B B*. The casting is then rested on the legs *C C*, and the six holes in the side are drilled. The removal of the finished work may be quickly accomplished by loosening the setscrews *K* and *M*, and the lever *J*, and then removing the lid *D*.

The three jigs shown and described in this article will serve as practical illustrations of three separate and distinct types of jigs, and show how, by the use of simple and inexpensive tools, uniform and satisfactory results may be obtained at the minimum of cost and the maximum of production in the machining of parts where, as stated before, a limit of error is allowed. One point which cannot be too strongly impressed on the designer of such tools is to allow of excess of metal at as few points as possible; that is, only at the locating and squaring surfaces of the jig. The habit of leaving unnecessary surfaces to be finished is expensive, and not consistent with satisfactory results.

In the next article of this series we will take up the more accurate and positive class of jigs, as used in the drilling of parts, in which all possible accuracy is desired when finished, and show how much unnecessary labor and parts may be dispensed with in their construction without in the least affecting the accuracy of the work produced in them.

* * *

COST REDUCTION.

A subject that does not get into print for discussion as frequently as formerly, but which must be considered every day in shop practice, is that of the relative advantages of the planer and milling machine for certain classes of work. We have recently learned of a shop where lathe beds have been milled for several years and now a plan is under foot to change the system and resort to planing. The question was threshed out among those in a position to have their say. The time had arrived when either new milling machines or new planers had to be ordered and with the outcome that the planers were bought.

On the other hand we are acquainted with a shop turning out similar work where a three-spindle milling machine is being used with entire success and satisfaction in milling lathe beds, both roughing and finishing, and the change was made from planing with improved results.

It may give much satisfaction to reduce the cost of machining lathe beds from, say $2.00 to $1.00 apiece, but this item is not so important in point of cost as the item of scraping that comes after, and in estimating the pros and cons of this or that method of machining, the question of what method will reduce the labor of the scrapers will play an important part.

Discussions and information concerning such problems are always of interest, but they are likely to be of less actual value than discussions of some of the ways and means of producing smaller parts of machines. The cost of fitting is generally the item that is worth attacking, and it is fully as important on small pieces as on the large ones, because there are more of the small ones and their labor cost is often much greater than that of the big pieces. It is also easier to detect time thrown away on large than on small work. The large pieces have a way of staring one in the face, while the little pieces slink out of sight and are not thought of.

* * *

The first successful electric railway lines in the United States were built at Richmond, Va., and Scranton, Pa., in 1887. Siemens had constructed one in Berlin, in 1879, and Edison an experimental one at Menlo Park in 1880. The next seven or eight years were spent in experimental work, after which the electric street railway began to be widely adopted. Within a period of say fourteen years, it has spread to the present enormous mileage, so that almost every town of any commercial importance has one or more.

LETTERS UPON PRACTICAL SUBJECTS.

A HANDY THREAD, WORM AND DEPTH GAGE.

Editor MACHINERY:

I send a blueprint and description of a gage which I devised for finding the proportions of screw and worm threads, and the tools for cutting them.

The United States standard involute worm thread and the Acme standard thread have a flat top and bottom which necessitates grinding the thread-cutting tool with a flat end varying in width with the pitch. Solid gages are on the market for shaping such thread tools, but these are limited to a few common pitches, whereas odd or fractional pitches are very often required. This gage has an opening on one side between the jaws *B B*, of an angle of 60° for U. S. standard form of thread. On the other is an opening of 29° for the involute worm thread or rack cutter, and also for

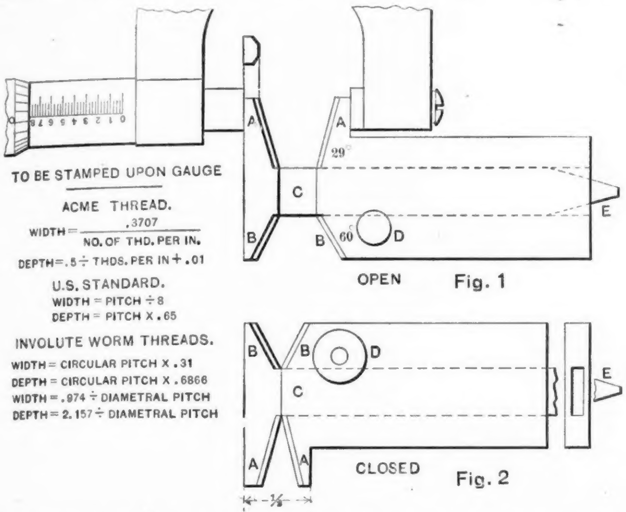


Fig. 1

Fig. 2

the Acme thread, which is the same angle as the worm thread or rack tooth. When closed, the angular sides of the openings meet, forming a sharp V, and the measuring points *A A* measure exactly .500″ or ½″ when closed. When the measuring points caliper 1 inch apart the tail end *E* of the slide *C* is just flush with end of gage. The formulas stamped on the sides of the gage are always handy.

In using the gage the proper width of point of tool is figured out by the formula and added to .500″. The gage is then set to the actual width of tool plus .500″ by a common micrometer caliper, as shown in Fig. 1. Proceed in the same way for the depth, except to subtract the actual depth of thread from one inch, and set the gage by the caliper as before.

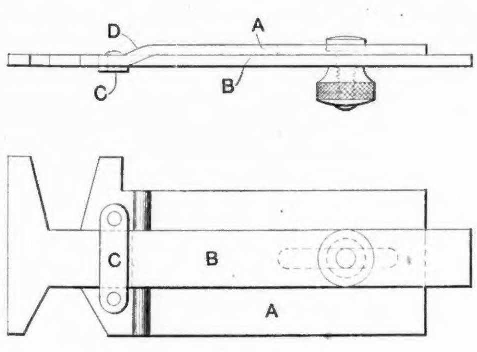


Fig. 3.

The following are some actual jobs I have had:

A hob and worm were to be made 3 1-3 threads per inch.

$3\frac{1}{3}$ threads per inch $= \frac{1}{3\frac{1}{3}} = \frac{3}{10}$ pitch; .3″ × .31 = .093″ = width of point of tool.

.093 + .500 = .593″, setting of gage.

.3″ × .6866 = .206″, depth of thread. 1.000 − .206 = .794″ = setting of gage for depth.

A rack cutter was to be shaped up, of .408″ linear pitch, to work with a spiral gear (Sellers motion).

.408″ × .31 = width of point of milling cutter + .500″ = setting of gage.

.408″ × .6866 = depth of rack tooth. 1″ − (.408 × .6866) = setting for depth.

A single-thread screw was to be made of 7-16″ lead, Acme standard form of thread.

$\frac{7}{16}''$ lead = $2\frac{2}{7}$ threads per inch. $\frac{.3707}{2\frac{2}{7}} = .0052$ = width of tool.

$$\text{Depth of thread} = \frac{.5}{2\frac{2}{7}} + .01$$

The gage shown in Figs. 1 and 2 is made in the same manner as a common caliper gage. Fig. 3 shows a simpler form of this gage. A piece of sheet steel *A*, is offset the thickness of the stock as at *D*. A cut is made in the offset portion of *A* for *B* to slide in. A piece *C* is riveted to *A* to keep the slide from coming away from *A*. A slot is cut in *A* for the tightening screw to slide in. I think it is preferable to have the tail end of the slide square, as shown in Fig. 3, and not pointed as in Figs. 1 and 2. Then when the gage is set for depth, an ordinary depth gage may be set from the thread gage and used for measuring the depth of thread.

Meriden, Conn. JAMES P. HAYES.

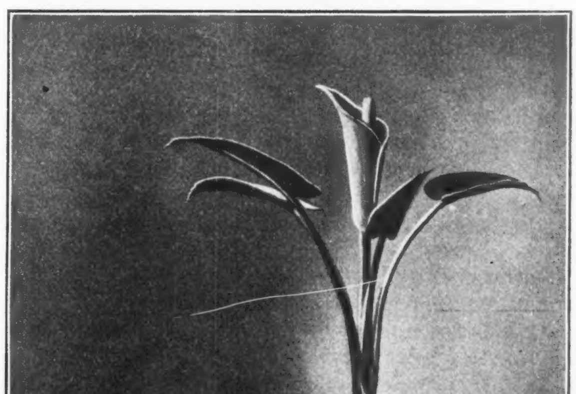
[Mr. Hayes has sent a sample gage for our inspection, which impresses us as a very convenient tool for the purpose described. When cutting an Acme thread in the lathe, the gage may be used for setting the lathe tool square with the work.—EDITOR.]

* * *

AN INTERESTING SNAKE—REMARKABLE FORGINGS.

Editor MACHINERY:

It is considerable satisfaction to one of the "old-time" mechanics in these days of labor-saving machines and devices for producing articles in metals quickly and cheaply, to see a specimen of thoroughly good old-fashioned hand work—something out of the ordinary, something that even in the old days would have been considered a curiosity and a job that it would have been hard to find many men with skill enough to make.



The Forgings.

The accompanying photograph shows a group of forgings which are interesting, to say the least. These forgings are made of steel, the several parts hammered out of a bar and welded together; and when you consider that they were made by hand in an ordinary blacksmith shop, with no tools except an anvil and a hammer, you will agree with me that they are fine samples of what a good mechanic—one who thoroughly knows his business—can do.

The lily and leaves are very pretty and elaborate, and show

much work and skill in their production. The whole piece is about 17 inches high, and is in good proportion both in regard to thickness and shape of the several steel parts.

The snake tobacco pipe, however, is the more remarkable of the two pieces of work. It is really a steel tobacco pipe, in the shape of a coiled snake holding a pipe in its mouth. The bowl is a perfect imitation, both in size and shape, of a regular "T. D." pipe. The coiled snake-like stem, when straightened out, is 27 inches long; the hole through this stem is of varying diameter. For some inches near each end it is as small as a common clay pipe, and in the middle it is about a quarter of an inch in diameter, varying to correspond with the varying diameters of the snake's body.

The thickness of the steel in this stem is about one-sixteenth of an inch, and the whole piece, from the top of the bowl of the pipe to the tip of the snake's tail, is made of one piece of steel forged by hand from a bar and welded throughout the entire length; and so well done is this remarkable weld that it is impossible to see where it is, even with the aid of a common magnifying glass.

These forgings were made by a young Scotchman, who learned his trade in the "old country," and has been working in Chicopee Falls, Mass., for several years. This is not a "pipe dream" but an actual fact.

Springfield, Mass. T. J. R.

* * *

CUTTING WORM THREADS.

Editor MACHINERY:

In the December number of MACHINERY, in the "How and Why" department, A. G. asks how to cut steel worms of 1-3" to 1-16" pitch. He further says he uses lard oil as a lubricant, and adds that the tool has 12 degrees clearance, and that the heaviest cut he can take is .002".

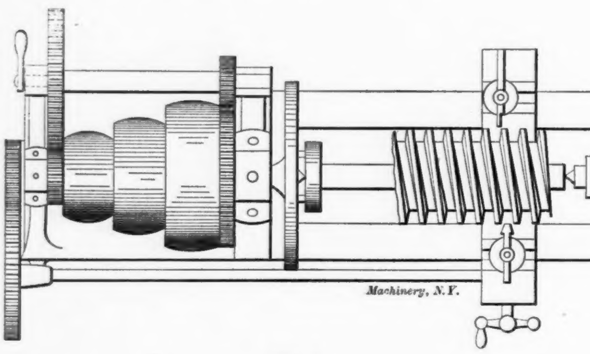


Fig. 1.

Small worms of this kind ought to be cut in a bolt cutter in long lengths, say, four or five feet long, and then sawed off to the required lengths; that is, of course, if they are "worms" only, not worm and shaft or the like.

If they must be cut in the lathe, however, it pays to rig up with a few attachments, as per Fig. 1. Put another tool post on a slide at the back of the carriage cross slide, and fasten it rigidly to the regular slide on the carriage. Put an ordinary cut-off tool in the post, right side up, and let it do the roughing with the lathe running backward. This tool should be of the same width as the space at the root of the thread, and should be set to the right or left of the 29-degree tool used in the front tool post, so that when the back lash of the change gears and the thrust of the feed screw are taken up backward both tools will cut accurately.

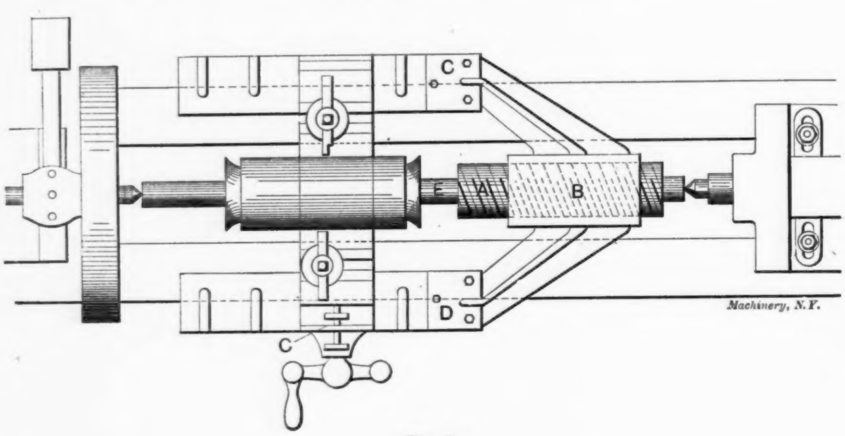


Fig. 2.

Fig. 2 shows a fixture in daily use at a Chicago shop for cutting worms of 1" pitch and from 1" to 6" lead, the diameters being from 4" to 10". It consists of a bracket *B* bolted to the lathe carriage at the points *C* and *D*. A lead or guide screw *A* was threaded to correspond with the worm to be cut, and was bored to fit a shaft *E* carried between the lathe centers. The bracket *B* was babbitted when in place on the carriage with the lead screw upon its shaft *E*. It shows no signs of wear after nine months' use. The lead screw was keyed to the shaft *E* so as to turn with the shaft and the worm, thus giving the carriage its required longitudinal motion. To allow for a slight adjustment the spline in the shaft was made at an angle with the center line of the shaft, thus enabling the lead screw to be rotated very slightly one way or the other, if required. The depth of cut was regulated by the gage *C*.

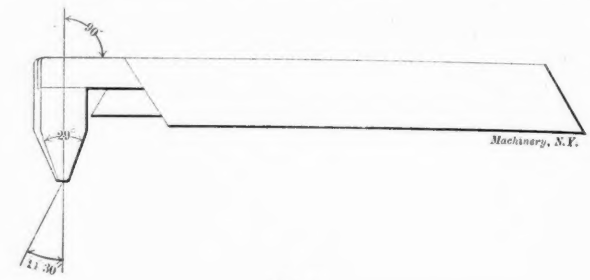


Fig. 3.

This rig reduced the cost of threading worms about 65 per cent. At the same time it was very inexpensive to make and is easily maintained, while the work produced by the lathe is superior to that done by the old method.

Fig. 3 shows a gage for testing the threads of a worm. It is similar to the ordinary keyseat or box rule gage, with the addition of the thread gage as shown. It has the advantage that it cannot be used wrong, and will show exactly where a worm is out. All our tools have 5-degree clearance on each side; that is, the inclination of the sides of the tool is 5 degrees greater than the inclination of the thread. I consider 12 degrees as used by A. G. excessive and detrimental.

Chicago, Ill. WM. H. BROOKS.

* * *

NORTH VS. SOUTH.

Editor MACHINERY:

With the near approach of spring, in almost every machine shop in the South one hears of one or two mechanics preparing to leave for the more temperate and congenial climate of the North. Naturally the questions arise, Is that wise? and why do so many machinists rush northward in the summer?

On the other hand, mechanics of the North hear of the large sums paid their brother workmen in the South, and of the rapid promotions which take place here. It must be understood that only the ambitious man, with skill, a clear head and an eye to business has any chance here; that the laggard will meet with as little success here as in the North.

The shops in the large cities and towns of the South are continually adding new and improved machinery, and, of course, require men with advanced ideas and shop methods. To this class the South appeals. There are quite a number of shops manufacturing Corliss engines and engaged in high-grade work which requires skill and accuracy, although the average shop runs mainly upon its repair work.

While 25 to 27½ cents is considered first class pay throughout the North, here the wages are from 30 to 35 cents an hour. All machinists do not, of course, get that, but those who cannot command 30 cents here, cannot get 25 cents at home. The price of living, for the single man, is not any higher here

and the possible objection to Southern cooking is overcome by the large number of Northern families who move here with the intention of furnishing board to Northerners. The price of clothing, however, is higher.

It is my experience that one meets with more civility in the Southern shops. The average of work required is not as large as in the more advanced shops of the North, and as the majority are repair shops or manufacturers of a rough class of machinery, the quality of workmanship required is not as fine or accurate.

But the Southern manufacturers are taking rapidly to Northern methods and are becoming keen competitors. So to the young man from the North with ambition and perseverance, the South offers advantages, and by a close observance of business and by economy he will undoubtedly attain in time a position of prominence.

Birmingham, Ala. GEO. L. RENNEISEN.

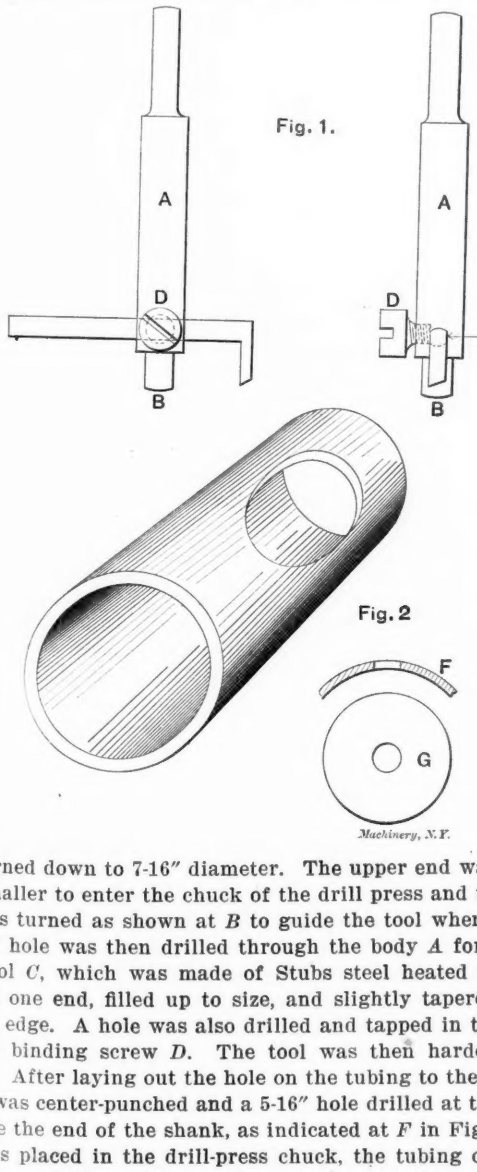
* * *

CUTTING HOLES IN ROUND SURFACES.

Editor MACHINERY:

I send the following sketch and description of a very useful and simple little tool for cutting out disks or holes in curved or round surfaces such as tubing.

We had occasion not long ago to use a lot of 2½" round brass tubing, Fig. 2, and wished to cut a 1½" hole through the side for a joint. This was rather difficult, when it is considered that the hole *E* was to be a nice fit on a piece of 1½" tubing. After trying various ways with little success, the adjustable tool shown in Fig. 1 was finally made and found to work satisfactorily. A piece of ⅝" round steel was centered



and turned down to 7-16" diameter. The upper end was turned still smaller to enter the chuck of the drill press and the lower end was turned as shown at *B* to guide the tool when cutting. A 5-32" hole was then drilled through the body *A* for the cutting tool *C*, which was made of Stubs steel heated and bent over at one end, filled up to size, and slightly tapered at the cutting edge. A hole was also drilled and tapped in the shank for the binding screw *D*. The tool was then hardened and drawn. After laying out the hole on the tubing to the required size it was center-punched and a 5-16" hole drilled at the center to guide the end of the shank, as indicated at *F* in Fig. 2. The tool was placed in the drill-press chuck, the tubing caught in the vise, and the cutting tool set to the required size. By starting the drill press and coming down lightly the hole was cut out nice and true.

This tool is also very handy for cutting out blanks in sheet brass when different sizes are required, like *G* in Fig. 2.

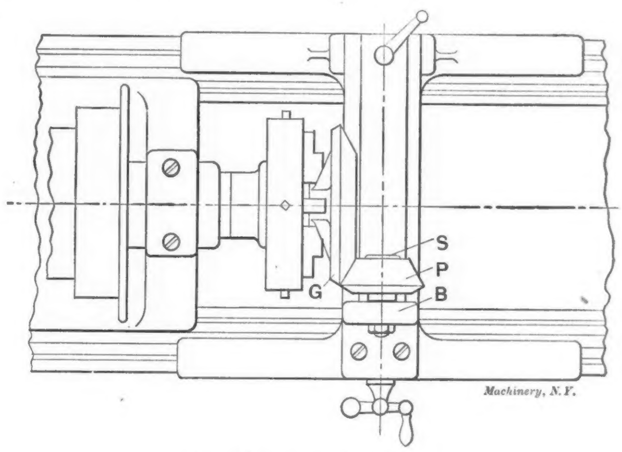
Brooklyn, N. Y. WILLIAM DORAN.

* * *

METHOD OF TRUING BEVEL GEARS FOR BORING.

Editor MACHINERY:

The writer submits the following sketch and descriptive matter relative to the method in vogue at our shops for truing bevel gears with cast teeth, preparatory to boring. I make no claim to originality, but simply offer it as the best method which has come under my observation, and hope the readers will tell us of any better scheme, if they have one.



Adjusting a Gear for Boring.

The bevel gear casting G is held by the hub in a four-jawed chuck and trued approximately by the tops of the teeth. A steel pinion *P*, a duplicate of the pinion which meshes with bevel gear when in actual operation, is mounted loose on a steel stud *S*, secured to a bracket *B*, which is fastened to a cross slide on the lathe, in place of the tool post, with the axis of the pinion at right angles with the ways of the bed. The cross slide is then elevated until the axis of the pinion stud *S* agrees with the center of the lathe spindle. The pinion *P* is then meshed with bevel gear *G*, which is adjusted until the two high sections of teeth show opposite. The bevel gear is then bored.

FREDERICK C. HILL.

* * *

WHAT IS A DRAFTSMAN?

Editor MACHINERY:

What is a draftsman? Is he a man with the ability to make beautiful things on paper, pictures emphasized by many shade lines and much ink; lines smooth and elegant, and dots and dashes that show no inequalities, but rather appear to have been made automatically? Is the man who produces such works of art the real thing, the whole thing, the only person worthy to be called a draftsman? There seems to be an idea running about in various places that such is the case, and that the prettier a drawing looks the better the man who made it. The practical worth of the drawing is not always considered by the careless observer, but the shop man realizes that the drawing with the most frills is occasionally the one with many dimensions missing, and the one that keeps him busy chasing up figures, calculating angles and doing other things which, while of the utmost benefit to his mental development, should hardly be necessary in the reading of an up-to-date drawing. Evidently, then, something more than artistic ability is needed in the making of a practical drawing.

Some time ago I had the pleasure of looking at as nice a piece of drawing as I have ever seen. When I say nice I mean pleasing to the eye; but on that whole sheet there was not one mark to indicate a finished surface, and I made the inquiry as to how the workman would know where a finished surface was wanted and where it should be left rough. Of course the reply was the same old one; I presume it has been given ever since the first drawing was turned out: "The man who works on that job ought to know enough to know what is to be finished without being told." A few months actual work at reading and working from drawings would have shown this man that he had omitted most important informa-

tion, but not being able to view the matter from the standpoint of the shop man he could find no deficiencies in his own production.

It is probably true that few men can expect to make a thoroughly practical drawing without an equally thorough practical training, and yet I am continually running across fellows in various walks of life who believe that a few dollars invested in text books or drawing courses, and a few hours spent occasionally in the study of the same, will be all that they require to fit them for satisfactory work in the drawing room. And this in face of the fact that men with many years of practical experience, and who have also devoted a great amount of time to study, are constantly striking problems that make them wonder "where they are at."

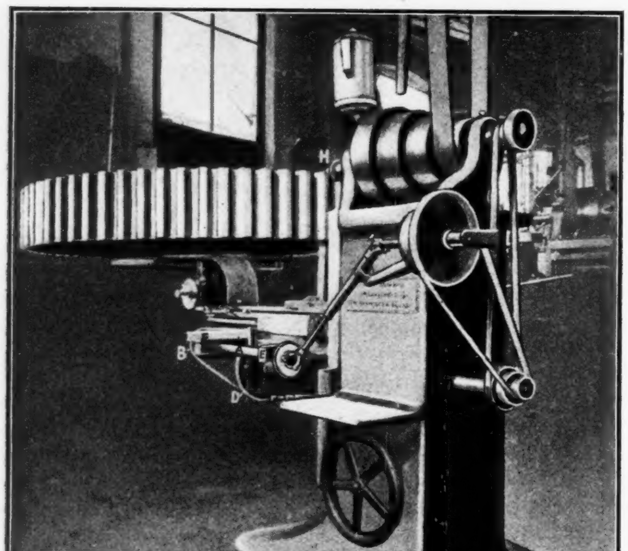
I do not believe the real draftsman is a forced product or a mushroom growth; that the practical man over the board to-day is the farmer, the clerk or the high-school boy of yesterday, but rather that he has reached his present occupation only after a long series of experiences in the shop, through which he has passed step by step, backing up the practical knowledge he has gained through the day by judicious reading and study outside of shop hours, until finally he has arrived at a point where he can design a piece of work and realize, as he designs it, something of the methods necessary to complete it in the shop and something of its use after completion. With his knowledge of the limitations of machine shops and machinists we may feel sure he will never lay out a job that will be beyond the power of mortal man to carry to completion. And with his remembrance of former experiences he will probably leave very few dimensions among the missing, or in fact omit any information which will be of benefit to the man behind the tools. N. W. FAY.

* * *

CUTTING THE TEETH OF A GEAR PATTERN.

Editor MACHINERY:

The accompanying cut shows how we cut a large gear pattern. The pattern had 72 teeth, a pitch diameter of 56 inches, and 8 inches face.



Milling the Teeth in a Large Pattern.

The milling machine on which the pattern was cut is a No. 1 B. & S. universal. First, we made an end cutter, *H*, the shape of the space between the teeth; then on the knee were fastened with clamps the strips of wood, *E*, *F*, to support the shaft *A*. Mounted on *A* is a grooved wheel, *B*, driving by a round belt the grooved pulley, *D*. The pulley, *D* is connected to the vertical screw of the machine by driving a square-holed bushing onto the handle square. This arrangement gives a vertical feed which could be reversed by crossing one of the feed belts.

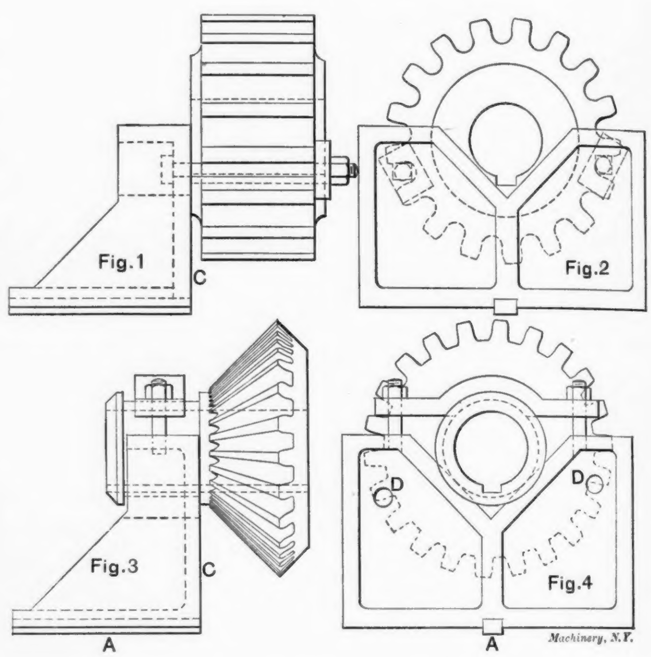
We had quite a number of gear patterns to cut, but the one shown was the largest. In this manner we did a very good job in a reasonably short time.

Lawrence, Mass. FRED. J. PERRY.

THE PLANT'S MACHINE SHOP.

Editor MACHINERY:

Many even moderate-sized plants, have their own machine shop to keep up the repairs and build such new work as can be handled. In fact, the machine shop is now the first part of a new works built, and it is pleasant to reflect that the machinist is as necessary, even if he is not always as ornamental, as the dude, and that his trade is as stable as any occupation, for every industry, and many of the comforts of private life, are largely due to his skill. Then if people are to be killed he builds the engines to do it, without getting close enough to "ax" them, for which some of our sailors and soldiers are no doubt truly thankful. Surely no further evidence of his usefulness to society need be mentioned. The rolling mill shop is referred to in the rest of this letter.



Combined V-block and Angle Plate.

It is of the first importance to keep in stock duplicate pieces of the parts of the mill or machines liable to break or wear out, in order that the least time possible shall be lost in making the repairs. It is not usually required that the extra pieces shall be made in any large numbers, for in that case the cost of maintenance and the expense of frequent stopping would call for a reconstruction of the machine itself; but rather "one of a kind" is the rule, the variety, however, being nearly boundless. In this respect it is desirable that there shall be as much of a family resemblance as possible between the individual members. For instance, if all the 4-inch shafts and wheels are keyseated the same key should will be reduced and a lot of data dispensed with that would be required if the width, depth and taper varied; and in many cases templets as well as data. The same idea is often made use of in making combination rigs, *i.e.*, one rig that is used to machine two or more pieces. This very materially lessens the number of special appliances that are used only occasionally.

The enclosed sketches show a one-piece V-block and angle plate, and how wheels without any similarity of shape are being held. Figs. 1 and 2 show a side and end view of a pinion being key-seated, while Figs. 3 and 4 are the same views of a wheel with a feather-way cut in it. The fixture is likewise serviceable for any purpose that a V-block can be used for, and were it not that the face *C* is planed ⅛ of an inch to the foot out of square with the table, it would not lack much of being an angle plate as well.

The rig as shown is adapted for planer work, but by removing the feather *A* it can be used on the drill press or other shop tool.

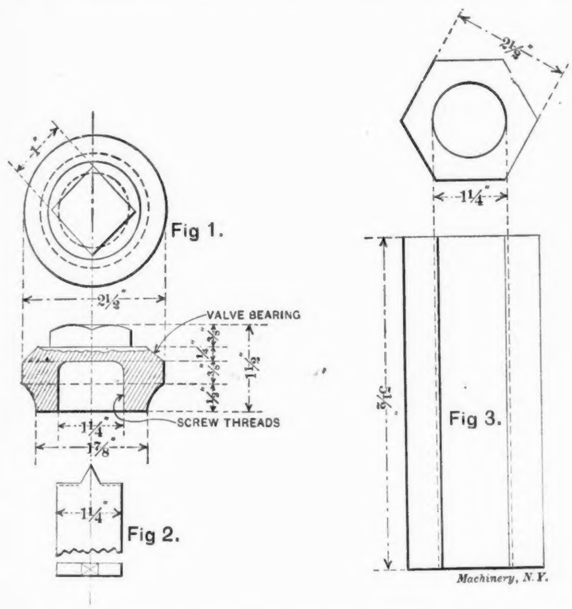
Youngstown, Ohio. J. H. DUNBAR.

MAKING PATTERNS TO SUIT LATHE MEN.

Editor MACHINERY:

Herewith I send drawings of two patterns that I have recently made, and, being made somewhat different than I intended, they may be of general interest.

Fig. 1 is a valve for an injector throttle, made to mold as here shown. As it could easily leave its own core, I proposed having this done to save metal; but the lathe man said they could be made more rapidly if cast solid, as he had a tool for the turret that would remove the stock and leave the hole the size for threading with one cut. So it was a question between the cost of about 5 cents' worth of brass, or the time to make two cuts instead of one. As the hole was only ⅞" deep, allowing five minutes for the time spent on the extra cut, and with wages at 30 cents per hour, it would cost only 2½ cents for the time. I am sure that five minutes will be considered excessive for the job. I am not very well posted



on such work, but I question if the boring and threading could not be done in less than that time. However, by leaving it solid, everyone was pleased.

Fig. 3 is a piece of brass, of hexagon shape and 5½" long, cored out, leaving ⅛" stock for boring and threading.

I have called this piece a pattern, but the cut shows the casting as coming from the foundry. It is used in making nuts to set the packing around the valve stem, and each nut is only ¾" thick when finished. In working, it is caught in a chuck, one end bored, threaded the full length, then each nut cut off the thickness required. The outsides are milled, planed, or ground on the emery wheel, whichever the foreman desires, previous to the lathe work.

Fig. 2 shows the end of tool used to bore the hole in Fig. 1 when it is cast solid.

Oneonta, N. Y. WM. NEWTON.

* * *

DEFECTIVE MACHINERY AND MATERIAL.

Editor MACHINERY:

While the present season of prosperity, like that of the past season, has its good features, I am inclined to the belief that in the greed to supply the demand a great deal of bad material, both finished and rough, is being put on the market. The writer set up a large shaper and a planer, both built by reputable firms. In both cases the work on them was bad, the planer being the worse of the two. In regard to rough material, let us take iron pipe. Having handled a great deal of it lately, I found a lack of uniformity in the threads—some very loose, others very tight, and all from the same lot. A great deal of it would crack open in the weld in the operation of threading. Again, in the smaller sizes there was trouble in making bends, either hot or cold, the pipe breaking in both cases; and the pipe appeared to be good, too.

As to pipe fittings, elbows are tapped on a twist, and not at right angles; couplings are threaded crooked; bushings have a straight thread on the inside, and crooked on the outside. As for reducers, it is almost impossible to make a good-looking pipe job, on account of the two threads not being in line. A great deal of machinery steel is getting to be as seamy and dirty as bar iron. Yes; I know competition is sharp, but as long as manufacturers are getting their prices, it is just as easy to make the stuff right as wrong.

Kern City, Cal. W. DE SANNO.

* * *

FIXTURE FOR MILLING BOLT HEADS.

Editor MACHINERY:

The accompanying half-tone and sketch represent a milling fixture to slot or mill the heads of large bolts. The ones shown in the half-tone are for crank counterweight bolts, which are made on a turret lathe from the bar. In this case the device

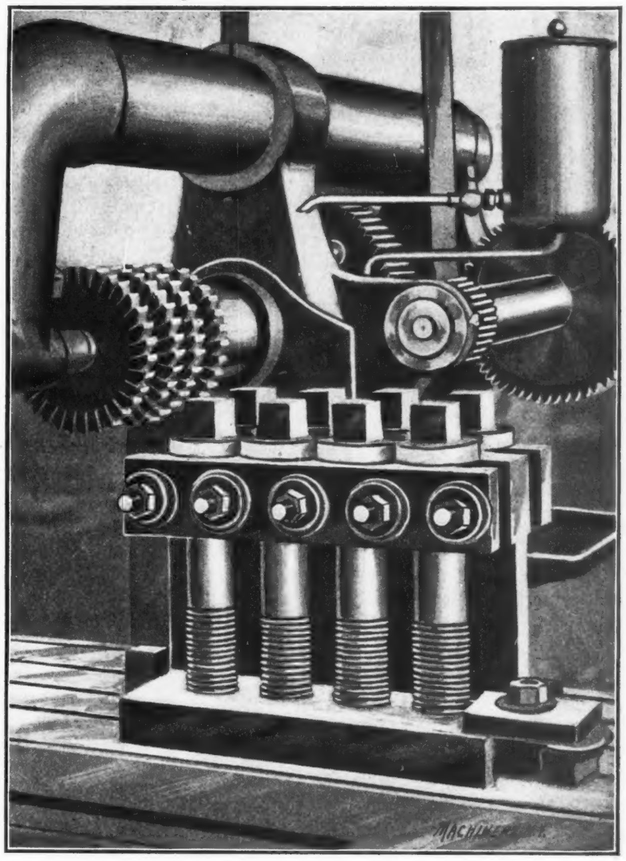


Fig. 1. Fixture attached to Milling Machine.

holds eight bolts, while the milling cutters, set in a gang, operate on two heads at once. After passing all through the cutters the bolts are loosened; the bolts to be operated on are turned one-quarter way round and set with a straightedge and clamped in position for a finish cut.

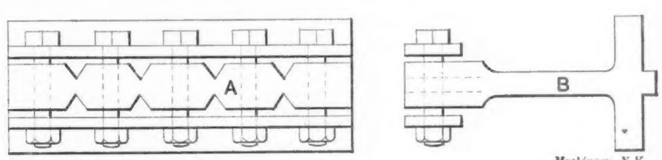


Fig. 2. Sketch of Fixture.

The writer devised a similar holder for a different class of work, which held twenty-eight pieces. This led to its use as a bolt-milling fixture, which has proved a useful rig for large bolts, and consists of a T-angle, as shown by sketch at *A* and *B*, with V's cut on opposite sides, and provided with clamps and bolts to hold the pieces.

Warren, Pa. A. A. AVERY.

* * *

A HEAVY REPAIR JOB.

Editor MACHINERY:

The accompanying cuts show how a shaft was trued up to fit a new gear wheel without taking it from the bearings.

The hoisting machinery at a coal mine had been damaged by fire, but had been repaired and reset, and had run about

two years. The drum shaft is 9 inches in diameter and 23 feet long, with a 10-foot gear wheel, *A*, Fig. 1, weighing 14,000 pounds in the middle of its length. The hub of the wheel is 24 inches long, with a 12-inch bearing, *B B*, on each side. The two drums, *C C*, are 8½ feet in diameter and 6 feet long, running loose upon the shaft, and are driven by friction clutches (not shown) which engage the outer end of the drums. The extreme ends of the shaft are supported by a bearing like the ones shown in the center. On account of the cracks received during the fire, it finally became necessary to replace the wheel, *A*. It had been loose on the key, and as it was recessed about 12" in the center of the hub, the shaft was badly worn.

The new wheel was made in halves, and bored small enough to allow for truing the shaft. We took the pinion *D* off the engine shaft, it being made in halves; but the old wheel being cast in one piece, we used dynamite on it, taking it off at fifteen shots without damaging anything else. We then ran two timbers, *E E*, diagonally from the floor to an overhead joist, and put a countershaft, *F*, on them. Two 24-inch wooden disks, in halves, with narrow strips nailed across for a face, did duty as a driving pulley in place of pinion *D*, and were

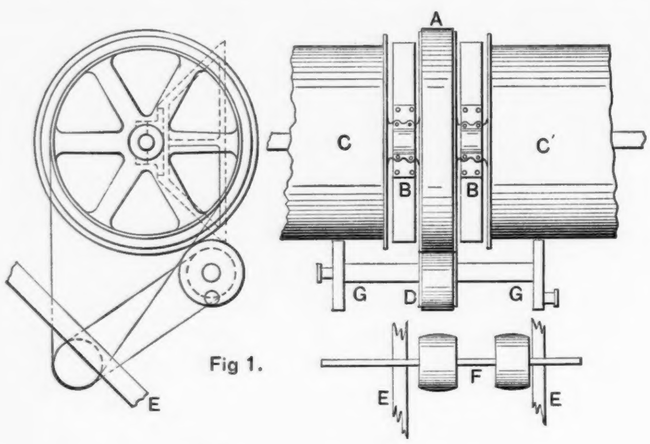


Fig 1.

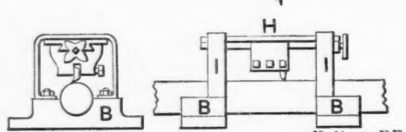


Fig 2.

belted to the countershaft. The hoisting cable was removed from drum, *C′*, and a belt from the countershaft was put in place around it, the clutch engaged, and the engine started.

The turning rig is shown on a larger scale in Fig. 2, being an old portable slide rest, *H*, fastened to boxes, *B B*, by wrought-iron brackets, *I I*, the caps having been removed.

We began the job on a Friday night, at the close of the day's run, and had everything in running order Monday evening, including the re-babbitting of bearings, *G G*, on the engine shaft, and some other minor repairs.

I notice in your March number a lathe dog for gripping threaded work. In our shop we split hexagon nuts and keep them handy about the lathes, and any old dog will do with these. When you want to split one in a hurry, just screw it on an old bolt; then go for it with a hammer and chisel, and if you cut with the grain, it will split like wood. Relieve the faces with a coarse file, and it is ready for use.

Birmingham, Ala. CHARLES C. STEWARD.

* * *

METHOD OF SECURING PISTON RODS.

Editor MACHINERY:

Where I am employed pumps are built, particularly central suction pumps having very thick pistons. There was considerable difficulty met in removing the rods from such pistons, as they were threaded for a portion of the thickness of the piston and secured by riveting over the end as shown in Fig. 1. The unthreaded portion of the hole in the piston fitted the body of the piston rod and in unscrewing a rod after its end had been beaded down and then clipped off, the battered thread would destroy or injure the thread in the piston. To obviate the difficulty some bright mind suggested turning down the end of the rod for a straight fit part of the way and placing the thread at the opposite side of the piston. The end of the rod could then be riveted over as shown in

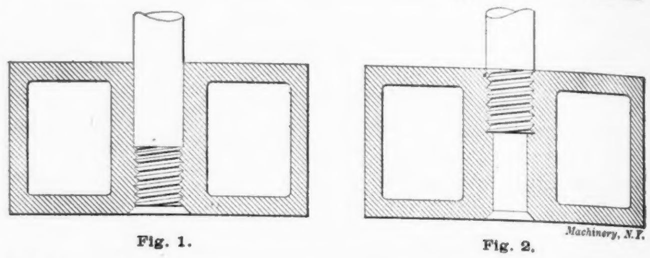


Fig. 1. Fig. 2.

Fig. 2, and when necessary to remove it there would be no injury done to the thread in the piston. Perhaps this suggestion will fit some other case.

Roxbury, Mass. WM. F. TORREY.

* * *

RIG FOR BORING HOLES IN A LATHE.

Editor MACHINERY:

Having had several steel castings to bore, the holes being 3" by 18" long, I found it to be a long-drawn-out job to bore same with a boring bar such as is shown in Fig. 1, especially when the cored hole (2¾") was somewhat out of true. I therefore decided to strengthen the boring bar in the following manner, which, after a trial proved to be a great saver of time. The bar and bushing shown in Fig. 2 paid for themselves in short order.

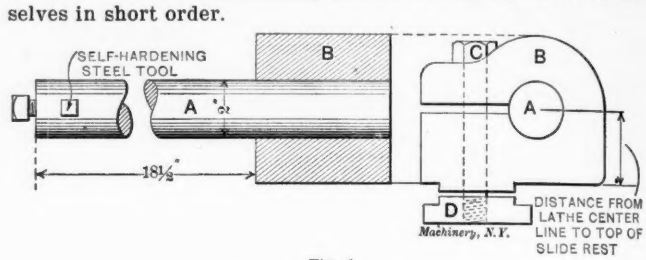


Fig. 1.

The taper hole in the end of the headstock spindle was 3" diameter, so I turned up a brass bushing, *A*, Fig. 2, to fit the hole in the end of the spindle, leaving enough stock in the hole of same to bore out after slitting with a hacksaw. I drove it home tight enough to make it safe, and still not too tight, as I wished to be able to drive the bushing farther into the spindle to take up the wear. The tool bar holder may be of any design suitable to hold a round boring bar.

I afterward decided to use this same bushing for smaller boring bars, and therefore made various sizes of split bushings of brass, as at *B*, Fig. 2, to fit holes in the boring bar holder and in the headstock taper bushing, both being the same size; for it makes the bars much stiffer, naturally.

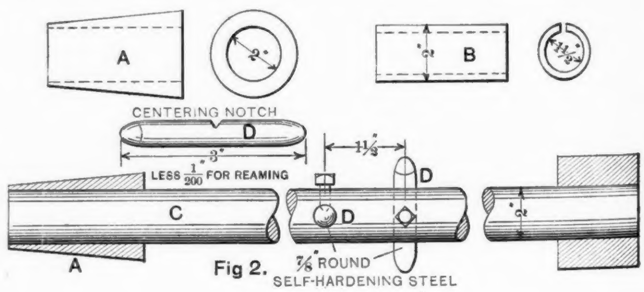


Fig 2.

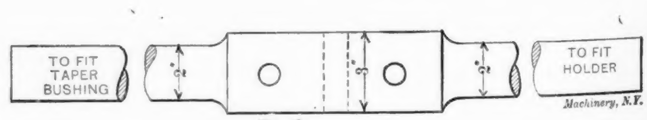


Fig 3.

To set the boring bar, I simply set the bar between the centers with the holder on same, and move the slide rest in or out till the tongue on same matches the tool post slot. The distance being right from the center of the bar to the top of the slide rest, the bar will be in perfect alignment. For larger cored holes I use the same principle and a bar such as shown in Fig. 3, sometimes using three tools to break up the cut. I simply drill round holes for the use of

round-self-hardening steel, and grind a V-notch in the sides of the cutters as shown in Fig. 2, for the set-over point. I find it much cheaper than using square steel.

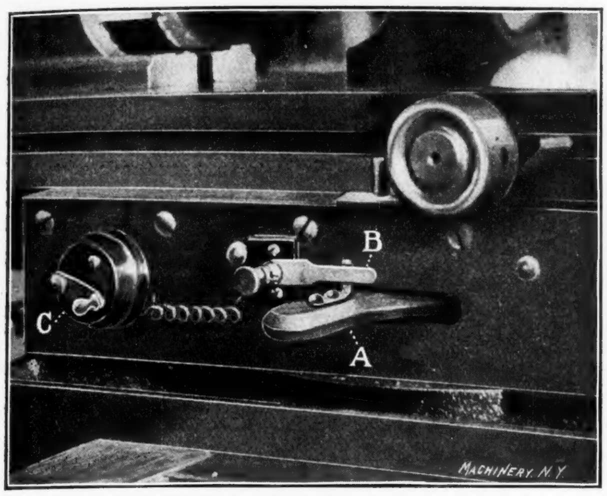
Chicago, Ill. HARRY ASH.

* * *

ELECTRIC ALARM.

Editor MACHINERY:

The accompanying illustration shows how an electric bell may be attached to any machine tool so as to ring a distinct alarm when the end of the cut is reached. In this instance it is shown attached to a milling machine, *A* being the automatic shut-off provided with a platinum point which engages with another platinum point on the spring *B*. When the cut is started the shut-off is thrown out of contact and so remains until the cut is ended when the shut-off throws over



Electric Contact Attached to Stop Motion.

into contact and rings the bell. The current does not stop the cut, it merely announces that the end is reached. *C* is a switch for turning off the current, for when the cut is finished the bell will ring until it receives attention. Only one wire is needed, the body of the machine serving to complete the circuit. It would naturally be expected that the current would not pass readily between two sliding surfaces when well oiled, since oil is a non-conductor, but in practice it is found that the surfaces in contact are so large and the film of oil so thin that the current will always find a passage through. The cut shows the attachment applied to a milling machine in a tool room where the operator was frequently called away to wait on customers and pick out tools, etc. The device proved so successful that it has since been applied to several planers in the same shop, thus enabling one man to tend several machines at the same time.

W. H. SARGENT.

* * *

TAPER ATTACHMENT FOR TAILSTOCKS.

Editor MACHINERY:

I am running an old 26-inch lathe on general work. In making the taper fit on the piston rods and valve stems (locomotive work), I could not move the tailstock over far enough

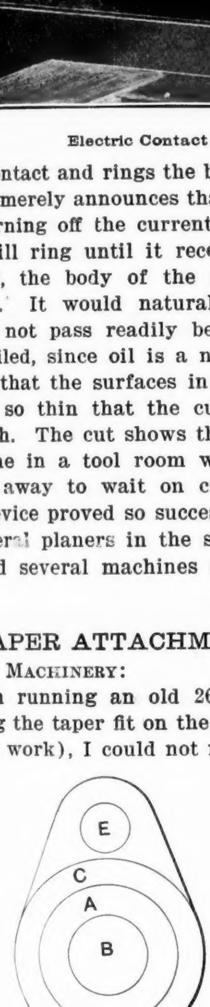


Fig. 1.

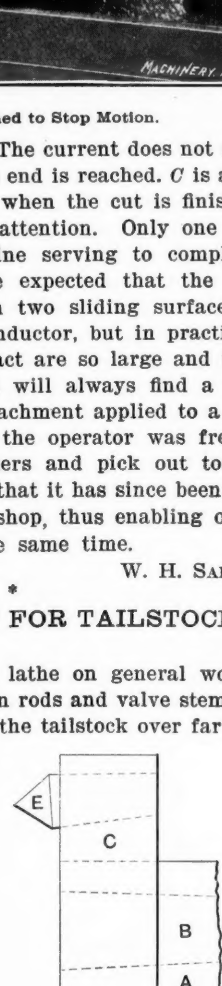


Fig. 2

to get the taper required, and in most cases was forced to feed by hand—which is all right when it comes out all right. To obviate the trouble, I took a stuffing box casting, *C*, Figs. 1 and 2, and bored it to a snug slip fit on the tail spindle *A*, and held it in place by the pinching screw *D*. In the opposite side of the casting *C*, hole *E* was drilled (at an incline) and reamed out tapering. Into this hole was fitted the center, *F*, Fig. 2. When making taper fits that the lathe will not provide for, I take out the center *B*, and put on the auxiliary center, *E*. This very often gives too much taper, in which case the tailstock is moved the opposite way until the right taper is obtained. It will be noticed that the center *E*, when in position, points toward the live center; the idea is to have the work revolve as near square on the center as circumstances will admit. The "jig" gives the best kind of satisfaction. It is the first arrangement of the sort I ever saw or heard of. If any of the readers of MACHINERY know more about it than the writer, now is the time to "speak out in meetin'."

Kern City, Cal. W. DE SANNO.

* * *

A COUPLE OF SCHEMES.

Editor MACHINERY:

In the factory where I am employed we have three hydraulic presses, with rams 20" x 8', working at a pressure of 1,500 to 2,000 pounds per square inch, each press making about 100 strokes every 24 hours. The cylinders are 20" diameter at the top for about 12"; in the middle of this space is a groove for the U-shaped leather packing, and below this the cylinders are 24" diameter. Two of the presses are bushed with brass ⅛" thick in this upper part.

These bushings were several times blown out by the pressure, and each time they were put back and beaded over on the bottom edge. Finally I pened them till they rapped solid all over; then I drilled in six dowels, and this kept them in place; but the pening left hammer marks, which are objectionable. Receiving orders one day to bush the third press, I thought I would go at it in a different way.

Putting in a solid turned and bored bushing was objectionable, as I did not think it could be forced in tight enough; 5-32 was the required thickness. I cut a strip of 5-32 sheet brass wide enough to extend down ½" into the 24" part of the cylinder and about 4" too short to reach around the cylinder. Then I cut off each end on an angle to give a taper of 1" per foot, bent the piece roughly to 20" diameter and placed it in the cylinder with the large end of gap uppermost. I then fitted in a wedge or keystone of the same material, and drove it in with a sledge till I could drive it no more; after which it rapped as solid as the iron itself all over. Six dowels were next drilled in, and the bottom edge of the liner was beaded over and finished. This made a first-class job, and was a good deal cheaper and quicker, and in my opinion tighter, than a turned bushing of that size and thickness.

I see no reason why a pump liner could not be put in in the same way; at all events, I shall try it the first chance I get. This occurred two months ago, and the bushing shows no sign of coming loose.

I recently had trouble with the connecting rod key on the crosshead end of our engine. This is a 24 x 60 double Corliss; the taper of the key is 1½" per foot, and is held by a ⅞ setscrew. One engine was put together and started one day after having been off for repairs. After running a few minutes, the wrist-pin bearing began to pound badly. We stopped and drove the key three times; then watched, and it was found to back out about ⅜" each time, even when the setscrew was tightened up almost to breaking strain with a big wrench. The bearing, strap, keys, etc., are in good shape. I remedied the difficulty in the following manner. Four ½" holes were drilled with 3-16 metal in between them in the lower end of the key. Then we turned four steel washers ¼" thick, ½" hole, 3-16 eccentric, cupped on one side. The first washer was 1¼" diameter, and the others were made so that their thin sides were equal to the thick sides of the preceding washers. A ½" bolt through the key and the washer and a nut on the end of it completed the job. After the key was adjusted, the washer was turned around till it struck the strap; then the bolt was tightened. After that the key slipped no more.

Streator, Ill. J. DUNN.

O. M. & CO.—4.

THE NEW SHOPS AND HOW THEY WERE ARRANGED.

ELMER E. WARNER.

The new shops of O. M. & Co. were finally completed within contract time, and a brand-new equipment of machine tools was installed. The O. M. was as happy as a child with a new toy. He could not seem to settle down to his correspondence in the little upstairs office at the head of the erecting bay, but had to make a round periodically to inspect each tool and reassure himself that it was not all a dream. The clean and well-matched floor, the clear head room, the soft, diffused light secured by skylighting, and the cream white interior were a constant source of wonder and delight to him. It seemed as if some early dream of his journeyman years, long obscured by the smoke and grime and tense struggle in the little old shop had suddenly materialized. Suppose we follow him and the young man on one of the first of their trips and pick up a few kinks from the O. M. works.

"O. M.," says the Y. M., "I have figured in this lay-out to make a workman's muscle count as well as his brain. Here's a flat car, now, for running in castings from the foundry. Got the best ball bearings under it, and weight cut one-half by tubular steel construction. One man can shove five tons with ease, and a boy can run around with any ordinary load—thinks it's fun, too.

"Here are two one-ton travelers for handling work in these twenty- and thirty-inch lathes and for light erecting and fitting. Simplest and handiest thing in the world—an I-beam with cast arms at the ends and flanged wheels running along this track. Duplex, quick-acting, one-ton block hung from this cross trolley. Chain itself hooks around any ordinary piece of work as a sling. Track runs full length of bay, so we can use our travelers for transportation when inconvenient to run in with a flat truck.

"These lathes, you notice, have swing, length between centers and capacity of chucks marked on this brass plate on the headstock. Got a small swiveled tool tray on right hand end of carriage, too; always pays to have the tools used on any particular job set out by themselves and at the working point. Every one has a broad cast chip and oil pan also, to protect the floor. We run this iron truck half under at the back and shove the chips right over the back lip of tray when we empty.

"These ribbed cast-iron bench legs, with support for shelf below and at back, are all right. That base board keeps shop sweepings from working back. The one-inch shellaced poplar shelf below, with back board, furnishes a convenient place for temporary storage of pieces of work, blocking, lead hammer, arbors, etc. The bench top has a front plank of three-inch ash, eighteen wide; back plank, inch and a half, and twelve wide, tongued into it; perpendicular back board to finish off and keep small articles from working down behind bench six inches high.

"Three-inch shelf, one inch from top, inclined back slightly —very handy for setting out screws, small tools, liners, etc. Those legs have slots cast in them for screws, so there's no trouble about drilling, in case our foundryman gets too many old grate bars in his pour.

"These inclined bench lockers, with balanced sliding door, are very handy for men who have a great variety of fine work to do. You see, they are about two feet wide and three high. Twelve inches deep over all at the bottom; eight at top. Door slides up entirely out of the way. Shelves incline back slightly, so there's no danger of things falling off.

"Fine tools, such as surface gages, straightedges, large calipers or trammels, squares, etc., can be kept in much better shape in these than in drawers, and there's a good place on the upper shelves for the small odds and ends occasionally needed.

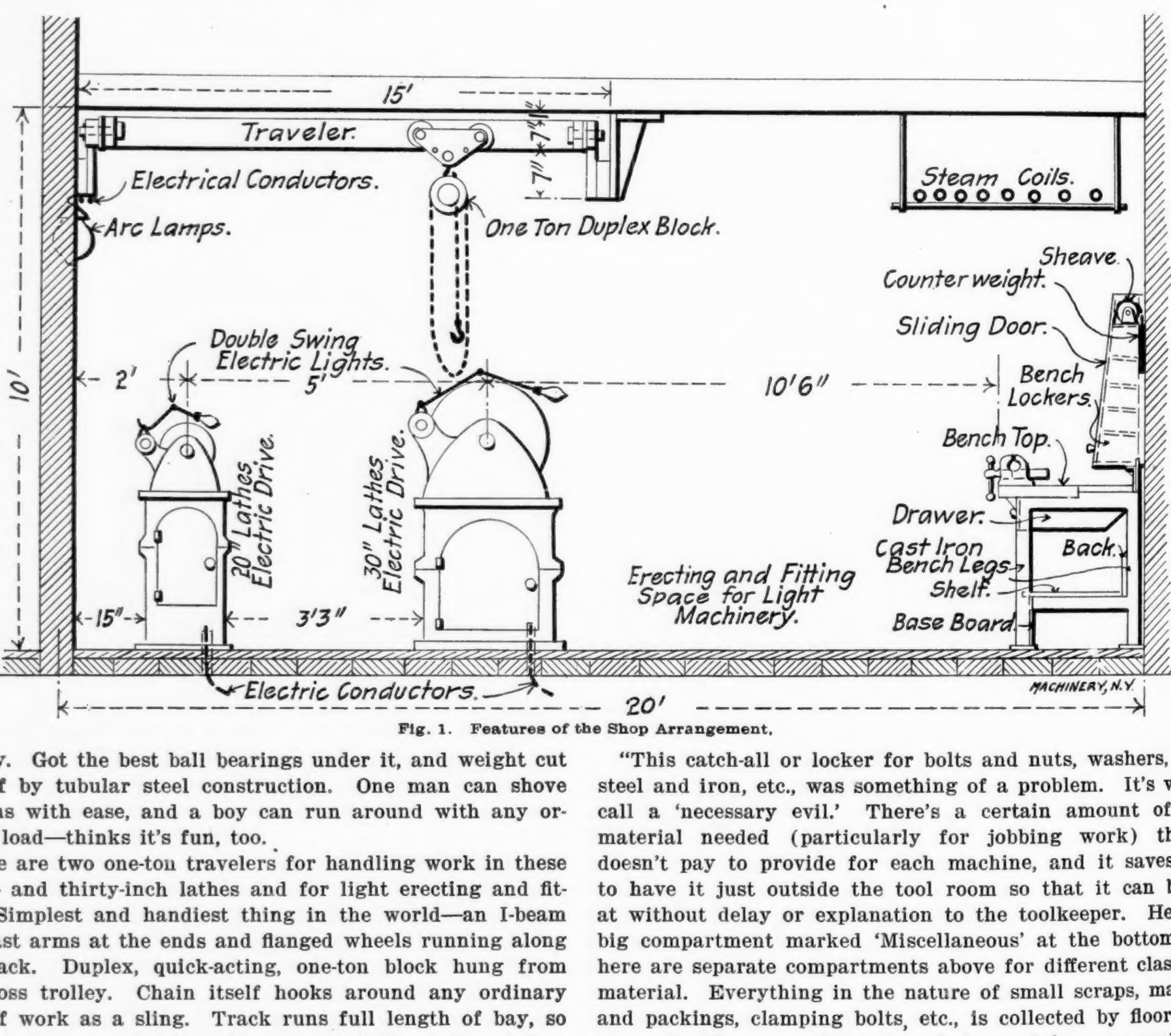


Fig. 1. Features of the Shop Arrangement.

"This catch-all or locker for bolts and nuts, washers, scrap steel and iron, etc., was something of a problem. It's what I call a 'necessary evil.' There's a certain amount of such material needed (particularly for jobbing work) that it doesn't pay to provide for each machine, and it saves time to have it just outside the tool room so that it can be got at without delay or explanation to the toolkeeper. Here's a big compartment marked 'Miscellaneous' at the bottom, and here are separate compartments above for different classes of material. Everything in the nature of small scraps, material and packings, clamping bolts, etc., is collected by floor helpers or by the men after use and dropped here generally on their way to the tool room. The tool room helper can keep it sorted out, and, under supervision of toolkeeper, can sort over scrap metal as it accumulates and send the most unusable sizes to scrap metal bins in the yard. You see it's a kind of localized depurating agency and keeps the shop from getting littered up.

"This upright mill in the tool-making department has both longitudinal and cross slides graduated, and a micrometer check for accuracy. By clamping jig plates on it and using these short stiff drills and rose bits we can move the whole platen the exact desired distance and drill and ream without any laying off—avoid the multiplication of error. That mill, with its auxiliary rotary table, is one of the most indispensable

tools in this department. Got a tapping attachment on it, you see, too.

"This electric center and general light portable grinder is a great convenience. Fits on any lathe in the shop. Clamps right in the tool-post block in most cases. Particularly handy for internal grinding. Setting right here on the bench, you'd think it out of commission, but even here it's ready for business. Just turn that key and you have a bench grinder for touching up light tools.

"For current on lathes we plug right in at the back of the headstock. Here's where we tap our motor circuit for light also. This double-swing bracket gives you the best combination of rigidity and flexibility. Can be brought right down under work or swung entirely out of the way, covered by half shade to shield the eye—green outside, aluminum paint inside.

"These drill presses all have small perforated cast trays on either side of the column for holding bolts, nuts and tools used on a particular job. No drill press ought to be considered complete without them nowadays.

"These three-tier trays on swivel casters are a great convenience. Run small castings around in them from one tool to another or set them at one side of tool to carry chucks, flat

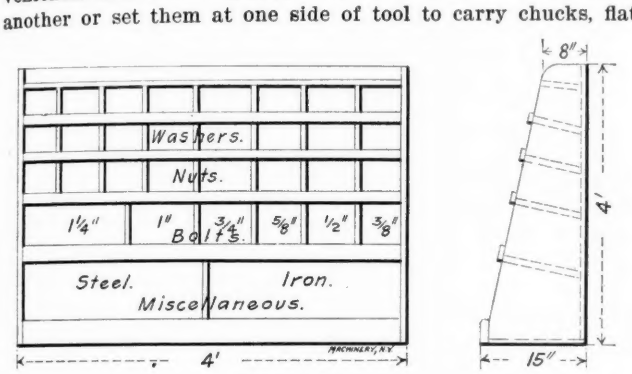


Fig. 2. Shelving.

vises, parallels, etc. Trays are 18" x 24" and an inch deep, pinned onto four three-quarter pipe legs usually eight inches apart. Caster shank drives right into lower end of pipe.

"But, O. M., you'll be specially pleased, I know, with these arrangements for the comfort of the men. Every man, you see, has his own expanded metal locker. No more hanging clothes around the shop over work benches. Sectional iron wash troughs, supplied with warm water. Overhead towel rack and soap powder, supplied by We, Us & Co., fed out of these receptacles by striking this knob. Doesn't cost $25 a year, and is worth a great deal more through convenience and keeping lockers clean.

"Here are two big shower baths for foundrymen and others. Wash a dozen at once in each. Here are lunch tables and steam coil for heating coffee. Bicycle rack down at the end of room near door, with foot pump and repair kit. 'Billy' that's our helper, is in charge of this room. 'Billy' calculates on making many an odd nickel cleaning up and caring for the boys' wheels, but it needn't cost them a cent. And here's the nucleus of our shop library. Something to read at lunch time that's worth remembering. It's only begun now, but, like most good and substantial things, it's got to grow, and grow through the interest and co-operation of the men.

"We must get them together some time before long and have a little talk and organize a Mutual Improvement Society. Pays, O. M.; it pays."

* * *

A very simple experiment to prove that smoke can be consumed is mentioned in "Steam Boiler Economy," a recent work by Mr. William Kent. He says: "A short piece of candle was placed inside of a tall, narrow tin cylinder. The deficient supply of air the candle thus received caused it to give off a column of black smoke. This was caused to pass into the central draft tube of a Rochester kerosene lamp, and as it passed up into the flame of the lamp it was completely burned, not a trace of smoke being visible in the lamp chimney. The experiment was also made with a still larger column of smoke by burning paper under the lamp with the same result."

THE RECORD OF FATHER TIME.

One of the chief objects of the Naval Observatory at Washington is to make observations for the purpose of distributing information throughout the country concerning the progress of Father Time, the authority by whom we must abide in setting our watches and clocks. Every precaution is taken at the observatory to secure accurate results, even to taking account of the personal error of the observer at the instrument. With so many accurate chronometers running in different parts of the country, a mistake of a fraction of a second in giving the time each day would be detected and discredit would be thrown upon the reliability of the apparatus and those in charge at the observatory.

The correct time is taken at night by observations upon the time at which some star passes a given point. For this purpose a telescope, called a meridian-circle, so swung that it can be set at any angle in the plane of a meridian, is trained upon the space in the heavens at which it has been calculated the star will pass at a certain time. Several parallel crosshairs are inserted in the eyepiece of the instrument, at a pre-determined distance apart. The observer is in readiness at the given time and when the star appears to traverse the first crosshair he pushes a button, by which the time of passage is recorded electrically upon a drum rotated by clock-work. This drum turns uniformly and a fluid pencil traces a line upon it. At intervals of one second the pencil is given a slight jump, making a serration or notch at regular intervals in what would otherwise be a straight line. When the observer at the telescope pushes the button, the pencil also jumps slightly, making a serration in the line at some point between two of the regularly spaced notches. Supposing the latter to be two inches apart, it will be seen that if the extra notch appears one-fourth of an inch from one of them, it will indicate that the button was pushed at an interval of one-eighth of a second after a certain second. The distance between the seconds' notches is made great enough so that 50ths of a second can readily be distinguished upon the record traced on the drum.

To return to the observer, when the image of the star passes the second crosshair, he again pushes the button, making another notch on the drum, and when it passes the third crosshair he pushes the button a third time. The time that should elapse while the images move from one crosshair to the next one is calculated and then the average of the observer's readings is taken, with this correction.

This average is assumed to be the correct time, except for the personal error, which varies with different people. That is, the impression of the star crossing the crosshair will be carried through the eyes to the brain and from the brain to the finger that pushes the button, quicker with some people than with others. To determine the allowance to be made for this, a machine has been arranged by which the observer can watch an artificial star pass the crosshair in an eyepiece and as it traverses the crosshair he pushes a button, making a record. The exact time at which the artificial star passes is positively known through the action of the mechanism which controls it, and the difference between the reading of the line on the recording drum and the known time of the passage of the object gives the personal error of the observer. By making repeated trials, this error can be found with great accuracy.

* * *

A portion of the B. F. Sturtevant Company's plant, Jamaica Plain, Mass., was destroyed by fire on April 14th. The company inform us, however, that the fire will not cripple them seriously, as only the engine and electrical departments were injured. The power plant was started up two days after the fire, and the entire blower, heater, forge, galvanized iron and shipping departments, with the foundry, pattern shop, etc., were in full operation on that day and the shipments going forward as usual. No valuable office records were lost, the most serious damage occurring in the advertising department, where a large amount of printed matter was destroyed. Fortunately, however, an entirely new general catalogue was in press at the time and copies were issued in time to meet all demands. There is no likelihood of any delay in shipments except such as may occur in the electrical and engine departments, and arrangements are already made for handling this work.

NEW TOOLS OF THE MONTH.

Under this heading are listed new machine and small tools when they are brought out. No tools or appliances are described unless they are strictly new and no descriptions are inserted for advertising considerations. Manufacturers will find it to their advantage to notify us when they bring out new products, so that they may be represented in this department.

A device by which split chucks may be used on an ordinary lathe or milling machine without the use of a draw bar, is being manufactured by Delivouk & George, 139 South Clinton Street, Chicago, Ill. The split chucks to be used must be specially adapted to the holder, as they should have a double angle to fit the angles of the male and female part of the device. When used with a faceplate the latter is recessed to fit a boss on the holder and is held to it by two screws. For milling machines it is provided with a shank to fit the taper hole in the spindle. It may also be used in the same manner for lathes, but is not so recommended.

The Newton Machine Tool Works, Philadelphia, Pa., have brought out a keyseat milling machine having two milling cutters, one of which is an end mill mounted in the end of a vertical shaft for finishing the ends of the keyseats and thus doing away with the necessity for drilling. The main part of the keyseat is cut with an ordinary cutter mounted on a horizontal shaft. After it has completed its share of the work the table carrying the shaft is moved outward until it strikes two stop screws, and then the vertical cutter is brought into action by moving the cutter head downward on its vertical slide. The equipment of the machine is such that keyways of various widths may be cut with little trouble in setting the machine.

The Curtis & Company Manufacturing Company, St. Louis, Mo., manufacturers of pneumatic appliances for the machine shop, have brought out a pneumatic elevator for manufacturing plants. This is especially adapted to locations removed from the source of power, as no belt connections are necessary and there is not the danger of freezing experienced with hydraulic elevators.

The elevators can be used between two positive stops only and are not adapted to stop at intermediate floors. They are made in sizes having capacities from 1,200 to 10,000 pounds, and with a lift up to 40 feet. The speed is in full control of the operator. As the air required is simply the volume necessary to fill the air cylinder when the cage ascends, a large reservoir and a small compressor are economical for elevator use.

To insure against accident, spring buffers are furnished for the upper level and there is a special rope lock, so that the cage can be locked at either floor required, making it impossible for a thoughtless person to cause an accident by starting the elevator when it is being loaded or unloaded.

UNIVERSAL RADIAL DRILL.

The machine illustrated is one of a new line of 6-foot plain, half and full universal radial drilling machines being built by Dreses, Mueller & Company, Cincinnati, Ohio. This machine is of the round column type, and is driven in the usual way from the lower cone through a pair of bevel gears and a central shaft. The outer column revolves around an inner stump, which, designedly, does not extend entirely to the top. Very often the machine is used without clamping below, and in this case the inner column represents the entire strength of the machine, which diminishes with the length of the inner column. This is apparent when it is considered that the outer column is necessarily the stronger of the two with any ordinary construction, and that it resists bending force only above the upper point of support of the inner column. Since the stiffness of the latter decreases with its length, it necessarily follows that increasing its height beyond such a point as will give a firm support to the pivot becomes a source of weakness instead of one of added stiffness. The column turns on rollers of large diameter, with alternate rollers between, which prevent friction between them. The clamping ring is straight and so does not clamp on top of the anti-friction bearing.

The principal new feature is the design of the friction back gearing by which the whole machine can be operated without resorting to the belt shifter. If the lever *B* with its adjustable handle *A* stands in the middle, the drill spindle is stationary; pushed to the left it engages the back gears; and to the right the spindle runs without the back gears. The pinion on the back gear is made double length. By sliding the large gear out of mesh with its mate and interposing a pinion which

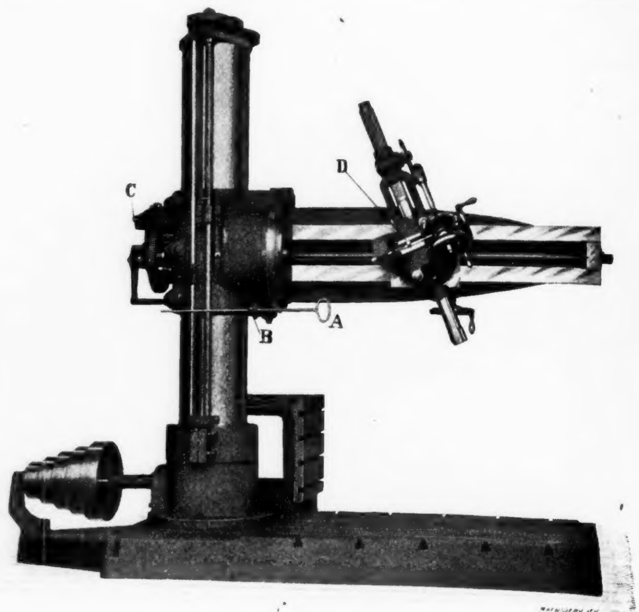


Fig. 1.

is moved by the lever *C* the same movements of the lever *B* and handle *A* cause the drill spindle to run slowly right handed and reverse quickly, a valuable feature for tapping. There is also a screw on lever *B* (not shown) by which the brake power of the driving clutch can be regulated and which prevents tearing taps when they strike the bottom of the hole or other obstructions. The spindle has a quick return operated by the large hand wheel on the head. The feed can be varied by the handle *D* while running.

HAND DRILLER WITH SCREW FEED AND CHAIN ATTACHMENT.

This convenient tool is being manufactured by Upton & Gilman, Lowell, Mass., to fill the call for a tool adapted to larger work than their bit brace driller. It is specially adapted to be used on all forms of structural iron work, pipes, columns, etc. The drill may be operated either by the ratchet or by continuous rotary movement of the handle. The frame is made with notches in which the chains may be engaged at any required point. A ball thrust bearing is provided to reduce frictional resistance. It is apparent that this tool also has its uses in the machine shop, often being available where the ordinary drilling ratchet and "old man" are employed.

Fig. 2.

HORIZONTAL BORING, DRILLING AND MILLING MACHINE.

The varied uses to which a horizontal boring machine may be put in the average machine shop undoubtedly make it a most valuable machine tool, as its general adaptability makes it well calculated for the large range of work. A defect of some horizontal boring machines has been the liability to become inaccurate and out of alignment. To avoid these troubles the Lucas Machine Tool Co., Cleveland, O., have abandoned the elevating table, substituting instead an elevating boring bar with suitable driving mechanism and with

the outer support geared to raise and lower with the spindle. In general design this machine somewhat resembles that of the Lincoln milling machine which has been so generally popular for manufacturing.

By adopting this construction the table is mounted directly on the bed, thus giving it a solid support. The bed is of deep box section, having three points of support to guard against springing when set on uneven floors. The table is made of liberal proportions to avoid warping when the work is clamped down. The gibbing is of the square lock variety with taper gibs which fit the entire length of the slide. The

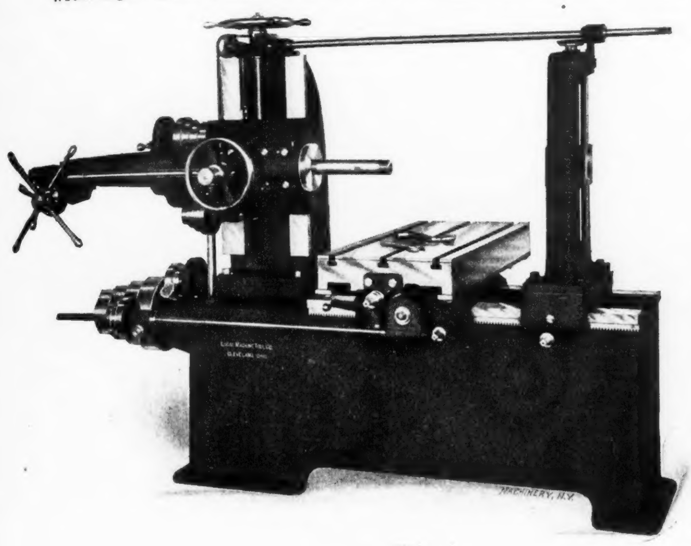


Fig. 3.

table is 18" x 42", and has automatic cross feed of 30", with six changes, and with automatic stop. The head is vertically adjusted by a hand wheel and screw, the motion of which is transmitted to the screw in the yoke by a horizontal shaft and bevel gears. The vertical adjusting screws have adjustable dials reading to thousandths. The yoke for supporting the outer end of the boring bar has longitudinal movement on the bed, and the outer support for the boring bar has independent adjustment for alignment. The boring spindle is made of crucible steel 2¼" in diameter, bored for No. 4 Morse taper hole and threaded on the end for chucks, milling cutters and other attachments. It is mounted in a sleeve terminating in a faceplate which affords convenient means for attaching face milling cutters or facing heads. The bar has quick and slow longitudinal hand travel conveniently arranged and four changes of automatic feed. All bevel gears are planed to insure quiet running and accurate movement.

Hill, Clarke & Co., Boston, Chicago and New York, are the selling agents.

THE AMERICAN CENTER GRINDER.

The lathe center grinder illustrated in Fig. 4 is manufactured by L. S. Heald & Son, Barre, Mass. It is designed to be sold at a low price and at the same time the intention

Fig. 4.

is to have its work as effective as that of more complicated machines in which the wheel is driven by power obtained either from the face plate of the lathe or from a frictional roll running on the largest step of the cone.

This grinder is clamped directly on to the tail stock spindle and carries a grinding spindle wheel at such an angle that it will grind the center to the angle of 60 deg. without possibility of error and without any delay from the cut-and-try method of setting up. It does not matter what the size of the tail spindle is or whether the lathe happens to have on a large or small face plate or any face at all, and as it uses hand power there are no connections to make to get power. It does not matter either whether the tailstock happens to be set over for turning tapers or not as the correct angle will be given the center just the same. This is important, for centers will wear more rapidly on such work and yet the workman is very apt to let them go if the grinder requires the tail center to be set back central to adjust it for grinding.

The grinding spindle is driven by sprocket wheels and chain and it is easy to get plenty of speed for the wheel. The sliding bearings are separate from the rotary bearings so there is no lapping out process. The rotary bearings are never uncovered and therefore the entrance of grit is wholly prevented. The particular advantages of this machine are its simplicity and ease of setting up.

KEY-SEAT MILLING MACHINE.

The engraving, Fig. 5, shows an improved keyseat milling machine designed for milling keyseats in shafting up to 4½" in diameter. The housing is heavy and is bolted to flanges on each side of the frame and to this the slide carrying the cutter spindle is gibbed. The spindle runs in boxes adjustable for wear and is powerfully driven. The driving belt is kept at constant tension by the use of idler spools and an idler shaft

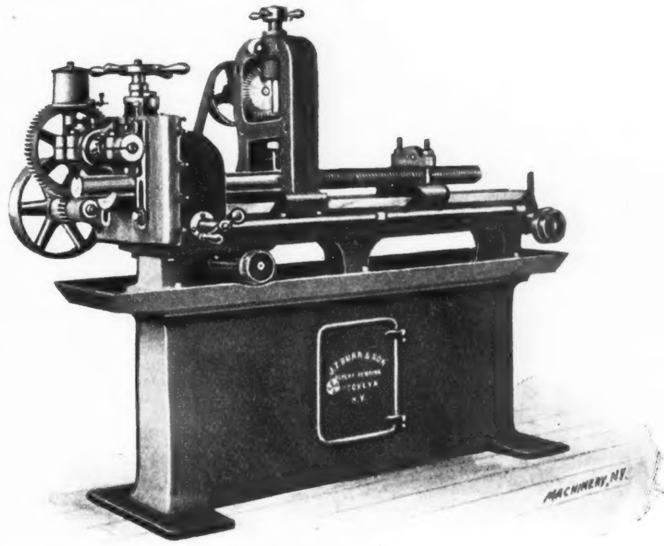


Fig. 5.

running under the frame of the machine. The slide, in addition to being gibbed to the housing, has clamping bolts which can be tightened after the cut has been sunk to the proper depth. A depth gage is provided so that the correct depth of cut may be obtained without the use of a scale. The feed for the shaft being splined is obtained by means of a worm and wormwheel and the feed can be tripped automatically at any point desired. The machine will mill 48" without resetting, but by unclasping the binder and running the carriage back any length can be milled.

The machine is built either with or without a routing attachment, as desired. This is shown in place in the illustration and serves to square up the ends of keyseats. It is conveniently located for its work, being directly in line with the axis of the shaft and with the slot that would be milled by the cutter on the horizontal spindle. The manufacturers, John T. Burr & Son, Kent Avenue and South 6th Street, Brooklyn, N. Y., will be glad to send further information.

COUNTERSHAFT AND FRICTION CLUTCH.

A new friction countershaft has been placed on the market by the Wilmarth & Morman Company, Grand Rapids, Mich.

The chief novelty of the countershaft is the friction clutches which the company will also apply to elevators, hoisting machinery, automobiles, and wherever it can be used to advantage. A detailed view of one of the friction pulleys is shown in Fig. 6. The shaft upon which the pulleys are located is splined for the reception of a rack that can be moved back and forth in the groove by means of a shifter handle which connects in the usual way with a spool that slides upon the shaft. This rack meshes with a small pinion

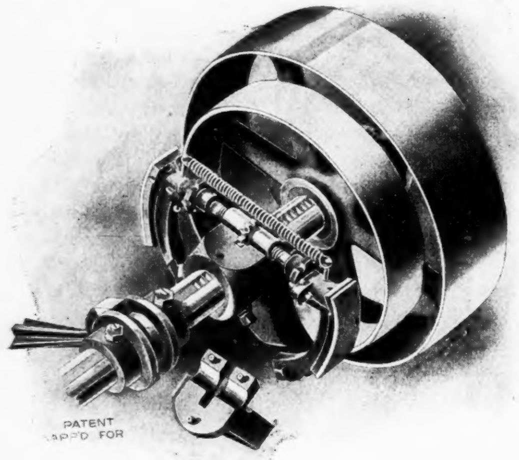


Fig. 6.

which is upon and forms part of a long cylindrical nut that turns in a bearing, one half of which is shown removed in the engraving.

This nut is threaded on one end with a right hand thread, and on the other end has a left-hand thread. Two rods, threaded to screw into each end of the nut respectively, are attached to the shoes that bear against the inside of the pulley and produce the frictional resistance required to drive the pulley. By moving the shifter handle one way these shoes are forced against the inside of the pulley rim with any degree

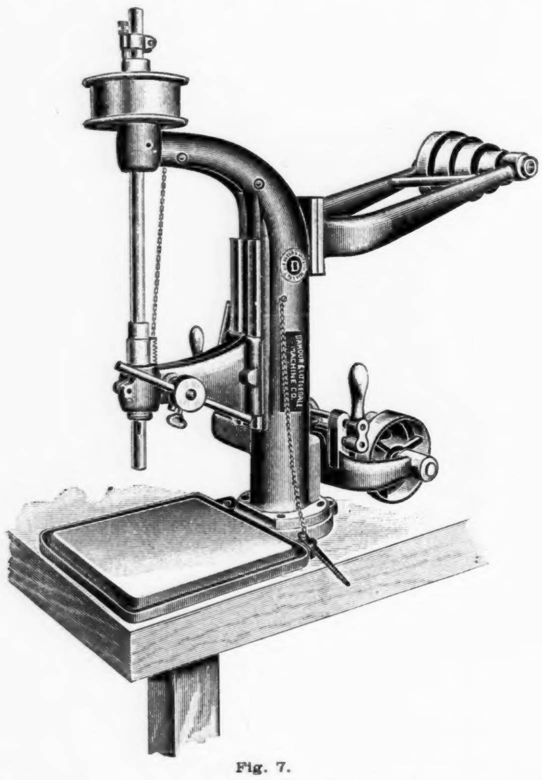


Fig. 7.

of pressure desired, and since the force is exerted through the medium of the screws, almost unlimited pressure can be obtained. When this pressure is the least, a spring takes up all back lash. A very moderate pressure can also be used. The extent to which this feature can be utilized is shown by the fact that a piece of work may be put on the lathe and cut in two with a parting tool without danger of breaking the tool, because the friction can be set just tight enough to drive the cut and to slip when the piece comes apart and pinches the tool. This same property makes it possible to slacken the speed, for measuring the surface of the work when stopping would leave a tool mark on the work.

When used over a lathe it can be made to act as a brake to quickly stop the machine by lightly engaging the backing friction before bringing the handle to the "off" position. No tools are required to adjust the friction, and belts need not be thrown off when making the adjustment.

FOURTEEN-INCH DRILL PRESS.

A 14" single spindle sensitive drill of new design is shown in Fig. 7. It is intended for drilling ½" holes or less. A special feature is the independent adjustment of the spindle head giving the capacity of a much larger machine. For a distance of 6" above the table the machine is capable of drilling to the center of a 16" circle.

The spindle is driven by a 1½" back belt and has three speeds. It has a steel rack and pinion feed and an adjustable stop. The spindle is entirely relieved of belt strain and the head is counterbalanced. There are provisions for taking up wear. The machine has a countershaft attachment to the column and can be placed directly under the line shaft without the trouble of putting up a countershaft. The illustration shows the machine as made for bench use. The same style is made in the form of a column drill, having in addition to the upper table a lower table for centering and drilling long work. The column machine is provided with bell and dead centers which fit the lower table. These drills are made by the D'Amour & Littledale Machine Company, 129 Worth Street, New York.

CHALLENGE HACK SAW DRIVEN BY ELECTRIC MOTOR.

In line with development of electric drive for machine tools the Patterson Tool & Supply Company, Dayton, Ohio, have recently brought out their Challenge power hack saw specially adapted to electric driving, the motor being practically an integral part of the machine.

The motor drives the saw frame through a worm and worm-wheel reducing gear, as shown in the cut. It is wound to give a quick return on the back stroke, and requires no starting box or rheostat. Stopping and starting of the machine are effected by means of a switch, and an automatic switch is provided which stops the saw at the end of a cut.

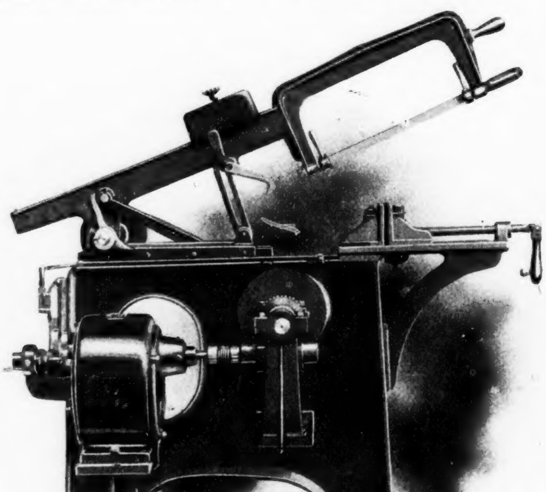


Fig. 8.

The feed of the saw does not depend on gravity, a powerful force feed being provided which is adjustable and which relieves the saw on the back stroke. This is an important feature in the construction of a power hack saw, as it greatly reduces the wear on the blades and increases their cutting efficiency. The machine, as a whole, is solidly built and all wearing parts are made adjustable, so that the effects of lost motion due to wear may be taken up. The adjustable vise has a capacity of 6 inches. It is also built for belt drive when so required.

PIPE THREADING AND CUTTING MACHINE WITH ELECTRIC DRIVE.

The Bignall & Keeler Manufacturing Company, Evansville, Ill., recently shipped to the United States Naval Academy, Annapolis, Md., an electrically driven pipe threading and cutting machine of heavy design which is the subject of the accompanying cut.

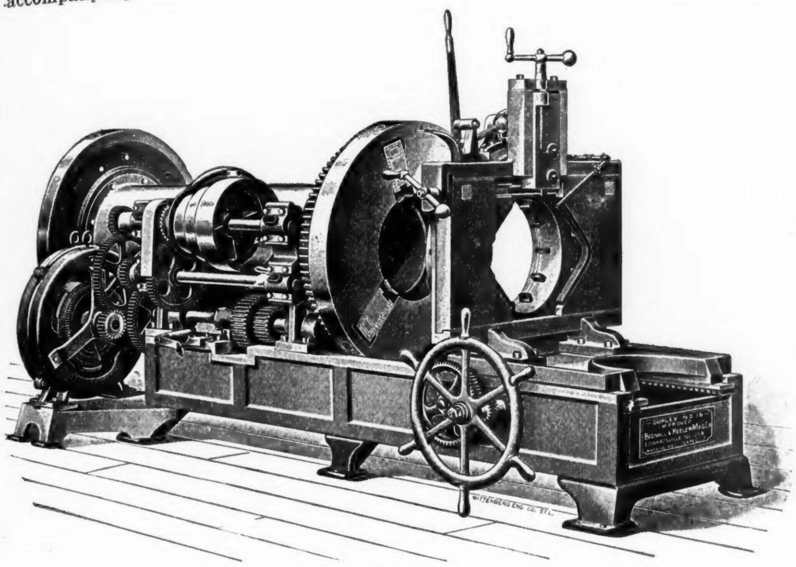


Fig. 9.

The machine is the same as their Duplex No. 16, which has a capacity of 7" to 16", with the difference that this machine will thread pipe as small as 6" in diameter and that it is specially designed to be driven by an electric motor. The motor provided is of 10 2-3 horsepower and of the Sprague-Lundell slow speed type. The machine is so designed that it may be driven either by the motor or by belt. The motor may also be used for driving other tools either when operating the pipe machine or not, as may be desired. The variable speed motor and controller furnished give twenty-four changes of speed to the arbor.

The inside diameter of the spindle or arbor is 17⅝ inches, which admits a 16-inch pipe with a coupling on the end. The die stand contains the standard die adjusting mechanism made by this company. The chasers are 12 in number, each measuring 15-16" x 1¾" cross section. The total weight of the machine without countershaft is about 30,000 pounds.

STEAM SPECIALTIES.

The Lunkenheimer Company, Cincinnati, O., have brought out two lubricators, illustrated herewith. The hand oil pump in Fig. 10 can be attached in either a vertical or a horizontal position by removing plug *B* and transposing it with the

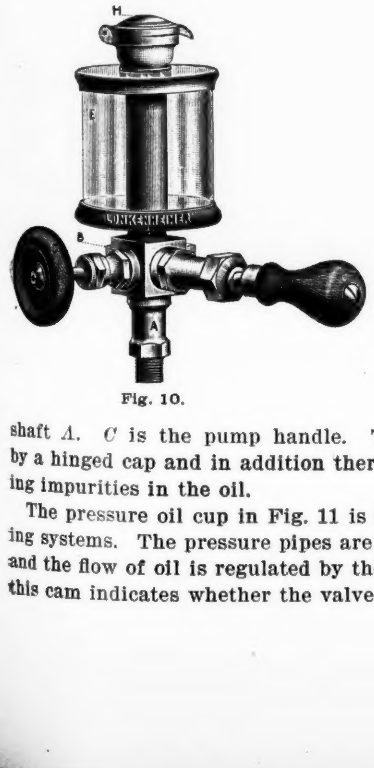


Fig. 10.

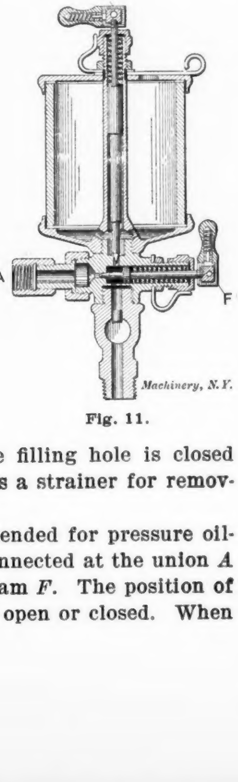


Fig. 11.

shaft *A*. *C* is the pump handle. The filling hole is closed by a hinged cap and in addition there is a strainer for removing impurities in the oil.

The pressure oil cup in Fig. 11 is intended for pressure oiling systems. The pressure pipes are connected at the union *A* and the flow of oil is regulated by the cam *F*. The position of this cam indicates whether the valve is open or closed. When the pressure system is in use, the needle valve controlled by the cam lever *C* is closed, so that the glass reservoir is not under pressure and is therefore not liable to fracture or leakage. When the pressure system is not in use, the oil cup can be used like any ordinary cup of this description.

In addition to these two specialties the Lunkenheimer Company have recently brought out an injector in which, when the quantity of water discharged is cut down, the steam consumption is reduced in direct proportion. This appears to be a novel and meritorious feature. The manufacturers claim that the injector will start promptly under most conditions, that it can be depended upon to work at all steam pressures, including very high pressures, and that it is not affected by wide variations of the steam pressure. Attention has been paid to the ease of making repairs.

TOOL ROOM SHELVING.

One of the problems connected with the operation of any manufacturing machine shop is that of providing proper and sufficient shelving for tools, dies, jigs, fixtures, patterns, etc. When wooden shelving is used it quickly becomes oil-soaked and splintered and is inconvenient when changes are necessary, the services of a carpenter being required, which means trouble and expense. To meet the call for a durable and elastic substitute, the New Britain Machine Company, New Britain, Conn., are building shelving of the construction indicated in the illustration.

This shelving is made entirely of iron and steel, strongly built to stand a very heavy load. The open construction

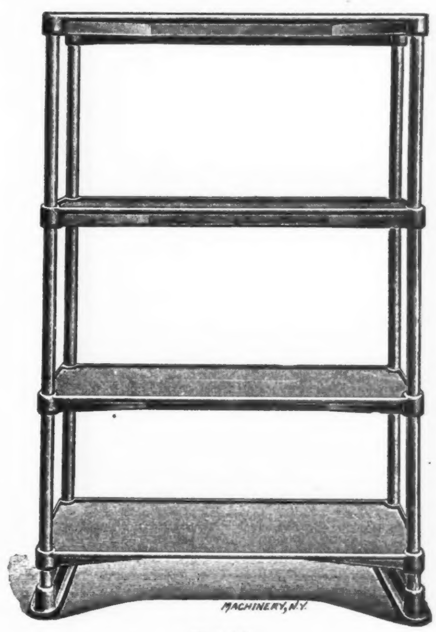


Fig. 12.

makes the shelving accessible from all sides and well lighted throughout. The base castings give an ample bearing surface on the floor for any reasonable load. Being built in units of convenient size, it readily conforms to the changing needs of any machine shop, as it may be added to or taken from with little labor, and the distance between the shelves changed to suit any particular requirement. The manufacturers point out that it is particularly adapted for use in fire-proof vaults which are now being provided by many concerns for the storage of valuable dies, patterns, etc. At present the shelving is made in four sizes: 42" x 16"; 48" x 20"; 56" x 20"; and 66" x 20".

* * *

The weight of aluminum required for electrical transmission is said to be almost exactly one-half the weight of copper. The chief drawback to the use of aluminum for electrical lines in place of copper is that unless it is very pure it oxidizes easily, and must be protected.

HOW AND WHY.

A DEPARTMENT INTENDED TO CONTAIN CORRECT ANSWERS TO PRACTICAL QUESTIONS OF GENERAL INTEREST.

Give all details and name and address. The latter are for our own convenience and will not be published

A reader of MACHINERY would like a recipe for chemicals or other substances that will cut or remove burnt grease from hot polished surfaces on a steam engine. Oxalic acid, he says, will cut the grease, but does not give satisfaction. He also wishes something that will cut and remove dried oil from cold polished cast iron or steel surfaces on steam engines. The tendency is for them to turn brown even though wiped with care. We submit these inquiries to our readers.

In reply to question 29 in the April number, about brazing cast iron, W. S. Corliss, San Jose, Cal., writes: I have had satisfactory results in brazing cast iron by placing a thin piece of sheet steel or wrought iron between the two pieces of cast iron. When I have had a small casting broken, I have fastened the pieces to a plate to hold them firmly in place, cut down through the crack with a hacksaw and then filed a piece of thin iron so it would fit the saw cut tightly, though the fit should not be close enough to spring the casting. The joint can then be brazed just as steel or iron is brazed, using plenty of borax, and a little more heat than in ordinary work. The saw should cut out all of the fracture, as when cast iron breaks there are always loose particles which brazing will not hold. The joint should be free from grease before brazing. I usually grind a little borax with water, and soak or rub the pieces before and after getting them together, as plenty of borax between the pieces helps a great deal. If any one who has had experience in brazing tries this method, I think he will have no trouble.

31. E. A. B.: Will it increase the tensile strength of a bar of machinery steel of about 1¼-inch diameter if it is heated and then drawn down to a diameter of ⅞-inch under a Bradley hammer?

A.—Yes. That is, the tensile strength per square inch of cross-section will be increased if the work is carefully done.

32. E. B.: 1. I enclose a sketch of a ball-bearing step that cracked at *B* in hardening. I used low-carbon steel, heated slowly, dipped with the groove down and it cracked in the water. I then made one and dipped it with the groove up and it cracked also. I then made two and drilled a 1-inch hole in the center, and these came out all right. I used fire clay in the 1-inch hole. I would like to have some reader explain why these pieces of steel acted in this way. 2. Is it good policy to grind lathe tools or tempered cutters on a dry emery wheel, dipping them in the water occasionally.

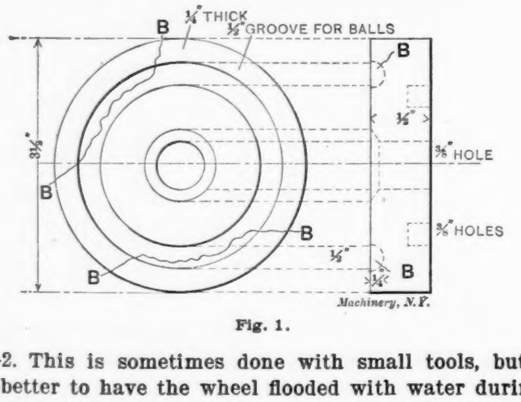


Fig. 1.

A.—2. This is sometimes done with small tools, but it is much better to have the wheel flooded with water during the grinding and thus prevent the temper from being drawn.

33. E. E. C.: I have had a discussion about the correct way to make a drawing. In the accompanying sketch the central figure is the plan view of a piece. Looking at the object from the side *C D*, should the elevation be drawn above the plan or below the plan?—each of which method is indicated in the sketch.

A.—Both methods are correct. With the elevation drawn above the line *A B*, the drawing is said to be in the first angle of projection. This is the method that has been quite generally taught in times past, but the tendency in both school and machine shop is to use what is called the third angle of projection, in which the elevation would be below the line *C D*. Assume the paper to be folded on the line *C D*, so that the plan view will come on top of the object and the elevation in front of it, between the observer's eye and the object. You will then have the views in their correct position relative to

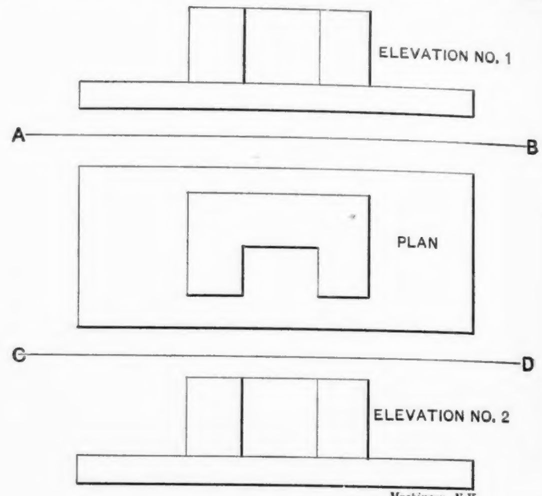


Fig. 2.

the object. We prefer the third angle of projection and you will find this system explained in Anthony's "Mechanical Drawing," published by D. C. Heath & Company, Boston.

* * *

The current issue of *Steam Engineering*, published by the Industrial Press, continues the discussion of smoke prevention by two articles, one from Prof. Benjamin and the other from Mr. A. Bement. The first takes up the smoke inspector's work on the railroads entering Cleveland, and the other discusses the chemistry of combustion in a simple and interesting manner. The remainder of this issue is of the usual high-grade character, with the additional feature of being a record of engineering progress. The busy engineer is kept posted on the progress of steam engineering all over the world by brief and clear descriptions of whatever is new and of value.

* * *

FRESH FROM THE PRESS.

Saw Filing and Management of Saws, by Robert Grimshaw. Published by Norman W. Henley, 132 Nassau Street, New York. 93 pages, pocket size. Price, $1.00.

This book will be found useful by any one who wishes to obtain a knowledge upon the care of saws, including saw filing, gumming, spring setting and swaging. There is also information upon the speeds of saws and upon various kinds and styles of saws.

The Principles and Practice of Linear Perspective, by Herman T. C. Kraus, C.E., published by Norman W. Henley & Company, 132 Nassau Street, New York. Large oblong size, with 14 full-page plates. Price, $2.50.

The subject is taken up progressively, elementary examples being shown in the first few plates. The plates towards the end of the book apply successively to examples of carpentry, parts of machinery, the location of objects at various distances and positions, the actual development of a perspective of a machine in different positions, the drawing of a desk in various positions, examples of architecture in parallel and angular perspective, the perspective of a gothic arch, the perspective of a series of underground pipes, examples of architecture and bridge engineering, and finally a design for a city hall in true perspective. To add that these subects are fully and clearly explained will give the reader a better idea of the scope of the book than could be obtained from a general description. The author has intended to prepare his descriptions so that anyone who has a fair knowledge of mechanical drawing can acquire a knowledge of perspective by the study of his book.

Steam Boiler Economy, by William Kent, A.M., M.E., published by John Wiley & Sons, New York. 458 8vo pages, illustrated. Price, $4.00.

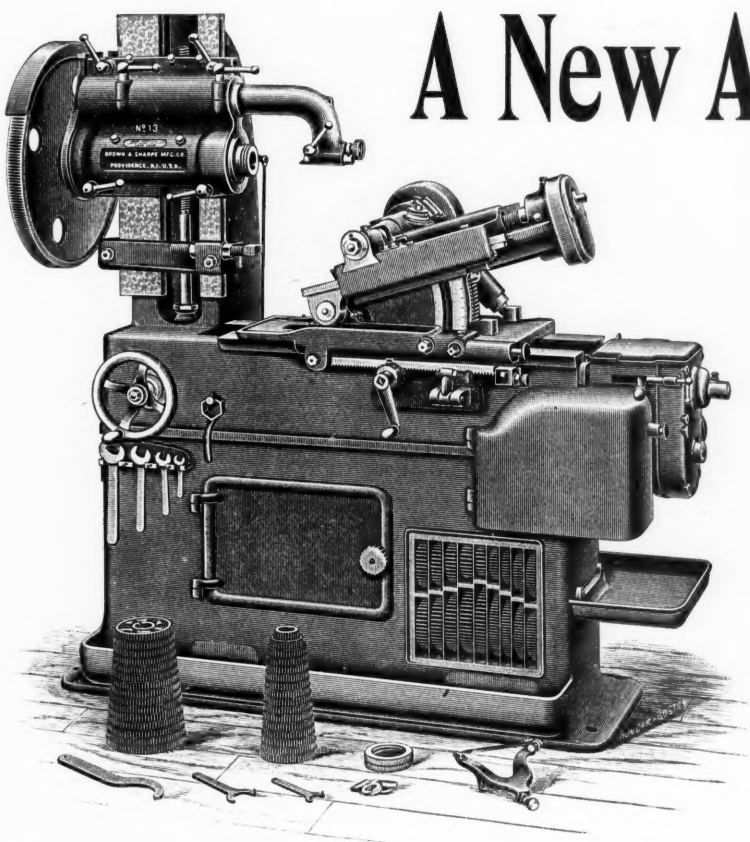
Mr. Kent is the author of the well-known mechanical engineers' handbook and has had an extended consulting practice in connection with steam plants, and is recognized as an authority upon this subject. A person interested in steam boiler economy, therefore, will naturally turn to these pages

Brown & Sharpe Mfg. Co.,

Providence, Rhode Island, U. S. A.

....PRESENT....

Another Example of Superior Quality of Workmanship and Design.



A New Automatic Spur and Bevel Gear Cutting Machine

Which embodies many new features that insure the production of more and better work than earlier machines of equal capacity.

Positive Indexing Mechanism that operates without shock, together with extreme accuracy of the Index Wheel, and its large diameter in proportion to the work, insures accuracy in the finished Product.

Ease and quickness of manipulation are important features that were not overlooked.

Improved Method of adjusting cutter and spindle.

Capacity: Spur and Bevel Gears to 18 in. in diameter, 4 in. face, and 5 diametral Pitch. Cutter Carriage adjustable to 90 degrees.

Special Circular, describing the machine in detail, mailed to any address.

New York Office, 136 Liberty St. *Chicago Office and Store, 23 South Canal St.*

with a great deal of interest, and we believe he will not be disappointed in what he finds. The book contains more definite information upon the economic features of boiler plants than any book that has heretofore been published. To illustrate, there is a chapter on heating surface in which are discussed the effect of various fuels, of circulation, the temperature of the gases, and other conditions upon the suitable area of heating surface. Grate and flue area, proportions of furnaces, etc., are taken up in similar manner. In another chapter are a complete discussion and calculations of the proportions of boilers for a street railway plant. A chapter that abounds in practical information has the heading, "Boiler Troubles and Boiler Users' Complaints," discussing twenty of the common complaints of those who are unable to operate their boilers successfully. Certain chapters, like Fuel and Combustion, Types of Steam Boilers, Furnaces, etc., are treated much as in other books, but if anything, more completely. The main difference between this and some other writings that have appeared on steam boilers is in the definite information given, as mentioned above, instead of the more general and less useful information that writers of less experience have presented.

ADVERTISING LITERATURE.

We have received the following catalogues and trade circulars:

Watson Stillman Co., 204-210 East 43d St., New York. Catalogue No. 59 of hydraulic benders. The list includes rail benders, girder benders, pipe-bending presses, shaft straightening presses, plate bending presses, and sheet metal benders.

Standard Welding Company, Cleveland, O. Catalogue of automobile parts manufactured by the welding process used by this company. These include tubing, steel cylinders, wheel rims, hubs, and various parts of the frame, etc.

Royersford Foundry & Machine Company, Royersford, Pa. Catalogue of punching and shearing machinery. This includes combined punch and shearing machines, single-end punches and single-end shears.

Grant Gear Works, 6 Portland Street, Boston, Mass. Catalogue of the gears regularly kept in stock by this company, or that are made to order. Both large and small sizes, as well as brass pinions, are listed.

The Hoefer Manufacturing Company, Freeport, Ill. Illustrated catalogue F of machine tools. Bench and column drills, and gang drills occupy a considerable portion of the catalogue. The balance is taken by descriptions of automatic wire machinery and special machines.

Blake & Johnson, Waterbury, Conn. Catalogue of rolls for jewelers' use, for flattening wire and rods, slitting machines, drop and power presses, thread-rolling machines, vertical milling machines, and various special and automatic machines for operating on wire and sheet metals. The catalogue is handsomely illustrated.

W. F. & Jno. Barnes Co., Rockford, Ill. Catalogue of metal-working machinery. The well-known line of upright drills made by this company are listed, together with the Barnes water grinder, foot power and engine lathes, the horizontal drilling and tapping machine, and an adjustable screw press, etc.

Chicago House Wrecking Company, West 35th and Iron Streets, Chicago, Ill. Monthly bulletin of 28 pages containing particulars about supplies in machinery, including electrical appliances, hardware, mill supplies, engines, pumps, boilers, etc. These supplies are obtained mainly by sheriffs', receivers', trustees', assignees' and manufacturers' sales.

The Garvin Machine Company, Spring and Varick Streets, New York. Catalogue of tools manufactured by this company and also of the extensive line of machine tools made by other firms which are sold at their New York store. The catalogue contains 90 pages of large size and is fully illustrated. The tools listed include all that are necessary for equipping an ordinary machine shop.

Hammacher, Schlemmer & Company, 209 Bowery, New York. Two catalogues Nos. 114 and 115, describing and listing respectively screws, bolts, nuts, supplies, etc., and tools for machinists and metal workers. Both of these catalogues are neatly bound in cloth, are of a convenient size for reference, and contain very complete lists of supplies and small tools for machine shops. They will be found convenient for any machinist who wishes to have lists of supplies and tools to refer to. Dimensions, prices and full particulars are given and the index of each catalogue is very complete. The catalogues are intended for the retail trade and they will be sent to any connected with machine shops who apply for them.

MANUFACTURERS' NOTES.

An error was made in the advertisement of J. T. Slocomb, Providence, R. I., manufacturer of micrometers and machinists' tools, in the last number of MACHINERY. It was stated that a group of twelve center drills, having the combined drill and countersink, were capable of drilling and countersinking 3600 holes. It should have been stated that they are capable of drilling 36,000 holes, or 3,000 holes for each drill.

The Patterson Tool & Supply Company, Dayton, Ohio, inform us that Mr. Jas. T. Mackay formerly travelling salesman for their company is no longer in their employ.

Mr. Wilson P. Hunt, Moline, Ill., formerly in the employ of Deere & Mansur Company, announces that he has started in business under the firm name of the Moline Tool Company to build special machinery and do general jobbing and repairing.

Owing to the increasing demand for their tools the Philadelphia Pneumatic Tool Company announce that they moved on April 10th from their former address to 1038 Ridge Avenue, where they will be glad to receive orders and fill them promptly and carefully.

The Cincinnati Planer Company, Cincinnati, O., are pushing their new building to completion, and expect to have it ready for occupancy by the first of June. This will give a total floor area of about 25,000 square feet. The buildings are one-story brick fitted with travelling cranes, and are well adapted to the building of heavy tools.

The J. Stevens Arms and Tool Company, Chicopee Falls, Mass., have made arrangements to sell and manufacture the rifle barrels formerly made by H. M. Pope. Mr. Pope will have full charge of all the work upon the rifle barrels and the best methods of the two companies will be combined in producing the barrels under the new management.

We are informed by the International Correspondence Schools, Scranton, Pa., that their Students' Aid department has been very successful in securing positions for many of their graduates. Many employers write to these schools for men competent to fill vacant positions and frequently students are suggested for these positions and are able to fill them satisfactorily.

The Wilmarth & Morman Company, Grand Rapids, Mich., report an extensive demand for the New Yankee drill grinder. They have recently received some twenty-two orders for these from prominent firms, among which are the General Electric Company, Schenectady, N. Y., two orders; Pennsylvania Steel Company; the United States Mint, Philadelphia; United States Navy Yard, Washington, D. C., and others.

In connection with the subject of forced draft the Buffalo Forge Company, Buffalo, N. Y., have sent us information from the Elmira Water, Light & Railroad Company, Elmira, N. Y., where they have installed a forced draft apparatus. The Elmira Company report that the saving on the first month's run with this apparatus amounted to 175,000 pounds of coal, and that the boilers could be forced if necessary much beyond that capacity.

Charles H. Besly & Company, 10-12 North Canal Street, Chicago, Ill., report that they are the western representatives and carry a complete stock of the Pecora machinery paints which have been on the market and have given satisfaction since 1862. These comprise flat steel color, egg shell gloss enamel finishing paint, Dresden machine enamel, iron filler, Pecora blow-hole cement. Their new May catalogue is now ready and will be mailed to any address upon application.

The Pancoast International Ventilator Company, 43 John Street, New York, and 223 South Fifth Street, Philadelphia, report a number of large sales. Their ventilators are adapted for shop and factory use, blacksmith shops, foundries and other buildings where it is desirable to keep a clear atmosphere, without danger of back draft or the admission of snow and rain. Among their recent orders are 150 ventilators for Honolulu, 50 to South Africa, 14 to Brazil, 18 to Mexico, and 13 to Australia. In addition to those over 100 ventilators of large size have recently been sold on domestic orders.

The equipment of the shipbuilding plant of the Fore River Engine Company at Quincy Point, Mass., exemplifies the varied applications of the fan blower. Draft for its boilers is produced by an induced-draft fan drawing the gases directly from the uptake flue and discharging them through a small stack extending only a few feet above the roof. Fan draft is likewise employed for creating the necessary intensity of combustion in the heating furnaces and forges while the smoke is removed from the forges through hoods communicating with an exhaust fan. All buildings are heated by the hot-blast system. The entire equipment of blowers and heating apparatus was installed by the B. F. Sturtevant Company, Boston, Mass.

The Bullock Electric Manufacturing Company, through its secretary, Mr. James Wilson Bullock, have acquired control of 15 acres of land directly opposite the present plant at East Norwood, Ohio. Upon this tract the Norwood Foundry Company will erect a foundry building 200 feet long by 150 feet in width; a pattern storage house, fire proof construction, 50 x 150 feet, three stories high, and a modern office structure. All these buildings will be built of buff pressed brick with steel frames and trusses to conform to the present buildings of the Bullock Electric Manufacturing Company. The plant will be of the most modern character, and electricity will be used for power and lighting throughout. While this foundry will be operated under the name of the Norwood Foundry Company, it will serve primarily the needs of the Bullock Electric Manufacturing Company. It will also be in position to handle outside orders.